Of this issue more than 4000 copies were printed

The Welding Engineer

Vol. 1 | Chicago 608 S. Dearborn St. | JULY, 1916 | $2.00 per year in U. S. $2.50 per year abroad | No. 7

Every Shop and Factory can use This Welding Process Profitably

Typical oxy-acetylene welding outfit, employing both gases (acetylene and oxygen) in portable cylinders of a convenient size.

The World's Largest Makers of Dissolved Acetylene

In thousands of shops and factories everywhere the Prest-O-Lite Process of oxy-acetylene welding and cutting is being used for the widest variety of manufacturing and repair operations.

This process will handle successfully certain classes of work that no other welding process can touch. For this reason you need it, no matter what other method you are now employing. Complete portability, economy and efficiency of oxy-acetylene welding are embodied in the

Prest-O-Lite PROCESS

Employs both gases (acetylene and oxygen) in portable cylinders. Prest-O-Lite ready-made acetylene for welding and cutting is prepared at twenty-two factory charging plants—additional distribution through thirty-five factory branches located in the principal industrial centers.

Acetylene gas as prepared by The Prest-O-Lite Co., Inc., is thoroughly washed, dried and freed from those impurities which are present in acetylene gas as delivered from a generator, thus insuring the highest possible flame temperature and a quality of workmanship that can't be secured otherwise. This means better welds, quicker work, and, in most cases, lower cost.

Prest-O-Lite Service, which covers the country like a blanket, avoids the large initial outlay and heavy depreciation incurred in making crude acetylene in a carbide generator.

We furnish high-grade welding apparatus for $60 (Canada, $75); acetylene service at extra cost, also adaptable for oxy-acetylene cutting by the purchase of a special cutting blow-pipe.

Thorough instructions are furnished free to every user. Any average workman who understands metals can learn the process quickly.

Information furnished on request.

The Prest-O-Lite Company, Inc.

U. S. Main Office and Factory, 851 Speedway, Indianapolis, Ind.
Canadian Main Office and Factory, Merritton, Ontario.
53 Branches and Charging Plants

*Alphabetical Index to Advertisers and Buyers' Index, Page 4.

The largest makers of Oxy-Acetylene Welding and Cutting Equipment and Supplies in the World

Oxweld Equipment includes Acetylene Generators, Welding and Cutting Blow Pipes, Regulators and Supplies—everything needed for all requirements—complete installations for the most extensive manufacturing and repair operations to portable units for emergency and field use. Because of the scientific accuracy and exactness of design—high quality materials and the mechanical perfection of construction and workmanship, **OXWELD EQUIPMENT** will produce the most efficient and economical results in welding and cutting operations of every character.

Oxweld Supplies are made up in accordance with the formulae of our metallurgists—tested by analysis in our laboratory and their merits tested out and proven by our expert welders in actual shop practice. We guarantee **OXWELD SUPPLIES,** when used by competent welders, to produce better results than any others known to the art today.

Our knowledge and experience, as the largest makers of welding and cutting equipment in the world, are always at the service of every purchaser and prospective purchaser of **OXWELD APPARATUS,** to determine the most economical and efficient applications of the **PROCESS** to the manufacturing or repair problems at hand.

Write us for information on any class of Welding or Cutting Work

Oxweld Acetylene Company

CHICAGO
36th St. and Jasper Place

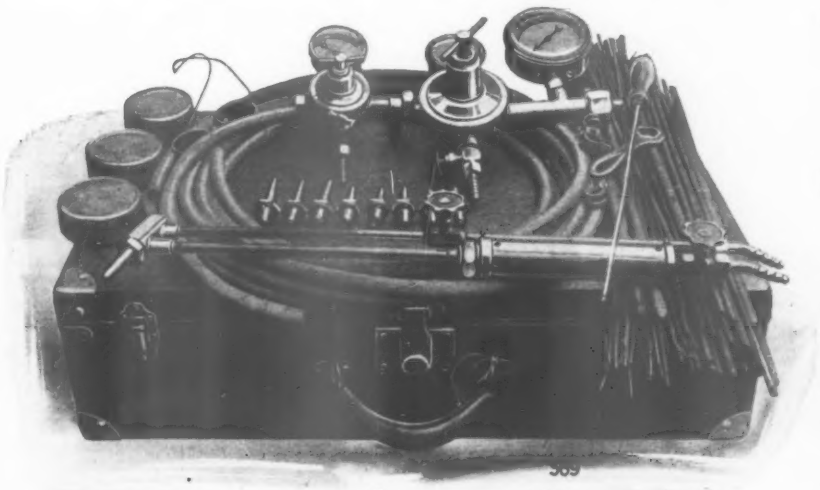
NEWARK, N. J.
6460-680 Frelinghuysen Ave.

LOS ANGELES
654-656 Pacific Electric Bldg.

The BUCKEYE Oxy-Acetylene Welding and Cutting Outfits

Stationary and Portable

We Build Preheating Kerosene Torches and Oil Furnaces



Live Men Wanted to Represent Us in Territory Not Allotted Only Men Who Will Demonstrate Desired

We Build Both Oxygen as Well as Acetylene Generators

Ask for Catalog K

THE MACLEOD CO., East Pearl Street, CINCINNATI, OHIO

Wrecking Huge Electric Plant!

The gigantic task of dismantling the huge abandoned Harrison Street Plant of the Commonwealth-Edison Company in Chicago is being accomplished in record breaking time by means of four outfits of

IMPERIAL WELDING CUTTING EQUIPMENT

= OXY-ACETYLENE PROCESS =

Mammoth engines, generators, fly-wheels, forty-two 350 h. p. boilers, coal hoppers—seemingly immovable, have been reduced to small, easily handled pieces of scrap, as if by magic, by the Imperial Cutting Torch.

The illustration shows a 24 foot fly-wheel in which the steel keys, 10 inches thick, were quickly cut although the sockets in which the keys were placed rendered the working conditions extremely severe.

Get our new catalog, telling all about the many exclusive advantages of Imperial Equipment, cost of operation and other valuable data.

Imperial Brass Mfg. Co.

522 So. Racine Ave. Chicago

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Commercial Acetylene Welding Co.
The Prest-O-Lite Co., Inc.
Universal Oxygen Co.

ACETYLENE GENERATORS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
International Oxygen Co.
The Macleod Co.
Metals Welding Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.

ALUMINUM FILLER RODS
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Mach. Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ALUMINUM FLUX
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ALUMINUM SOLDER

ANNEALING FURNACES
Buffalo Dental Mfg. Co.
The Macleod Co.
Universal Oxygen Co.

APRONS (Asbestos)
Welding Materials.

ASBESTOS GLOVES
Welding Materials.

ASBESTOS SHEET PAPER
American Oxygen Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

BLOW TORCHES (Acetylene)
American Oxygen Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
Indiana Oxygen Co.

BOOKS (Relating to Welding)
The Welding Engineer

BRASS AND BRONZE FLUX
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxy-Acetylene Products Co.
United States Welding Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Welding Materials.

BRASS SPELTER WIRE
Universal Oxygen Co.

BRAZING OUTFITS
Buffalo Dental Mfg. Co.
Superior Oxy-Acetylene Machine Co.
The Macleod Co.

BRONZE FILLER RODS
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

BUTT WELDERS (Electric Resistance)
Thomson Electric Welding Co.
Welding Materials.

CARBIDE (Calcium)
American Carbolite Sales Co.
Union Carbide Sales Co.
Canada Carbide Sales Co.

CARBON REMOVING TORCHES
American Oxygen Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Equipment Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
The Macleod Co.
Metals Welding Co.
Oxy-Acetylene Products Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Mach. Co.
Universal Oxygen Co.

CAST IRON FILLER RODS AND FLUX
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ELECTRIC ARC WELDING OUTFITS
Westinghouse Electric & Mfg. Co.
Welding Materials.
General Electric Co.

ELECTROLYTIC OXYGEN PLANTS
International Oxygen Co.
Universal Oxygen Co.

FILLER RODS (Aluminum)
Oxy-Acetylene Products Co.
United States Welding Co.

FILLER RODS (Swedish Iron)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Welding Materials.

FILLER RODS (Tobin Bronze)
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

FILLER RODS (Vanadium Steel)
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

FIREPROOF PLASTIC
Bermo Welding Apparatus Co.

FLUE WELDERS (Electric Resistance)
Thomson Electric Welding Co.

FLUX WELDERS (Electric)
Westinghouse Electric & Mfg. Co.

FURNACES (Annealing)
Buffalo Dental Mfg. Co.
The Macleod Co.
Universal Oxygen Co.

GASOLINE PREHEATING FURNACES
Buffalo Dental Mfg. Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.

GAS BURNERS (Preheating)
The Macleod Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.
Superior Oxy-Acetylene Machine Co.

GLOVES (Asbestos)
United States Welding Co.
Welding Materials.

GOGGLES AND HOODS (Welders)
American Oxygen Co.
William C. Adams.
Bermo Welding Apparatus Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
F. A. Hardy & Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.
Welding Materials.

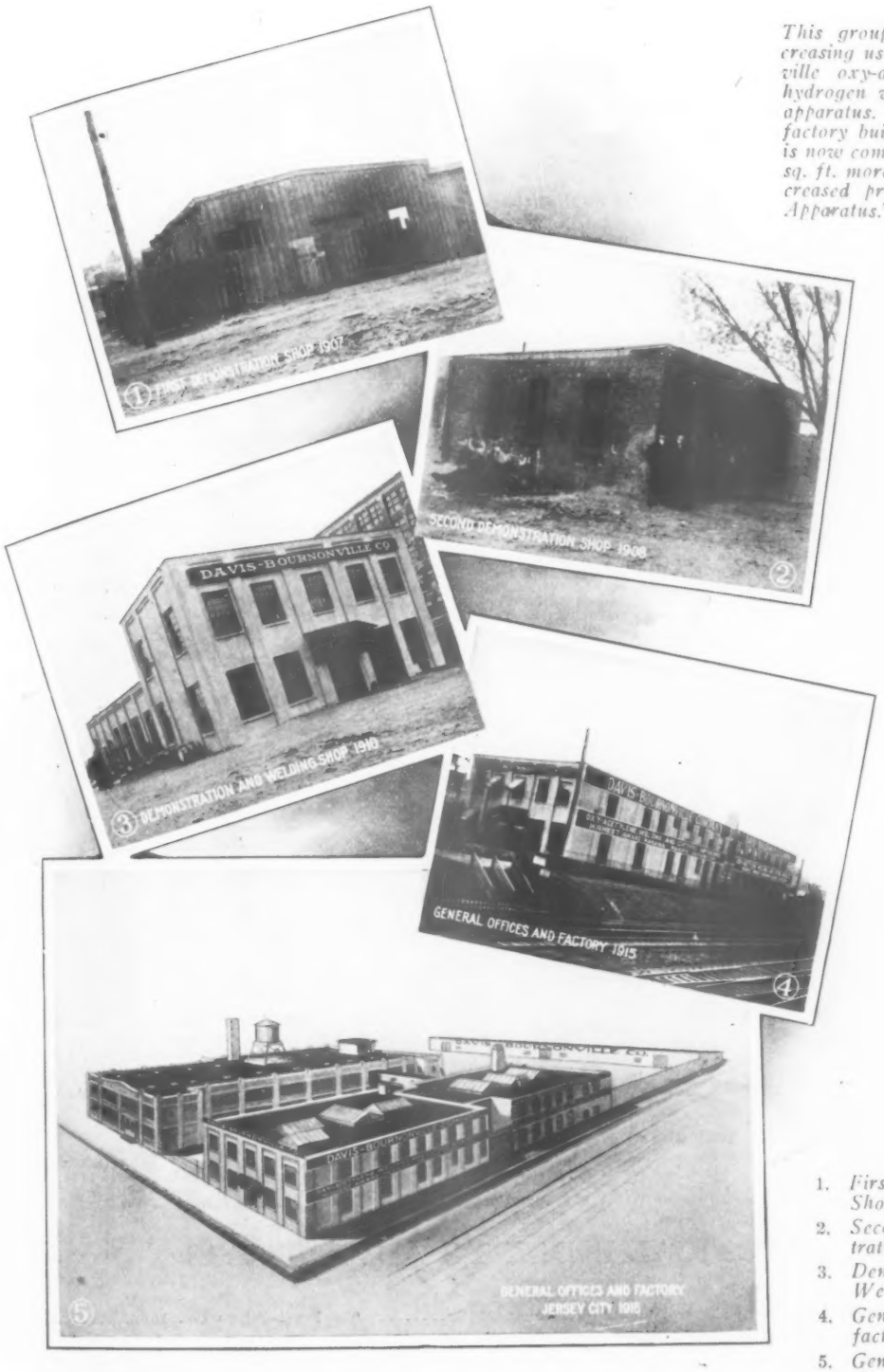
GLOVES (Welders Asbestos)
American Oxygen Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Universal Oxygen Co.

GAUGES (Pressure)
American Oxygen Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
United States Welding Co.
Universal Oxygen Co.
U. S. Gauge Co.

HARDENING FURNACES
Buffalo Dental Mfg. Co.
The Macleod Co.

From a Shanty to a Factory

This group indicates the increasing use of Davis-Bournonville oxy-acetylene and oxy-hydrogen welding and cutting apparatus. An additional factory building at Jersey city is now completed, giving 30,000 sq. ft. more floor space for increased production of "Davis Apparatus."



1. *First Demonstration Shop*, 1907.
2. *Second Demonstration Shop*, 1908.
3. *Demonstration and Welding Shop*, 1910.
4. *General Office and factory*, 1915.
5. *General Offices and Factory*, 1916.

DAVIS-BOURNONVILLE CO.

NEW YORK General Offices and Factory, Jersey City, N. J. CHICAGO

Sales Offices: New York, Chicago, Detroit, Cleveland, Pittsburgh, Philadelphia, Boston.

HOSE (Oxygen and Acetylene)

American Oxygen Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

HOSE UNIONS

Bermo Welding Apparatus Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.

HYDROGEN

International Oxygen Co.
Universal Oxygen Co.

KEROSENE PREHEATING TORCHES

Goldschmidt Thermit Co.
The Imperial Brass Mfg. Co.
The Macleod Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.

NEEDLE VALVES

Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
K-G Welding & Cutting Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.

OIL BURNERS (Preheating)

The Macleod Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Mach. Co.

OXYGEN (Compressed in Cylinders)

The Linde Air Products Co.
Swift & Co.
Universal Oxygen Co.

PIPE WELDING

Goldschmitt Thermit Co.

PHOTOGRAPHS

Chicago Architectural Photographing Co., (Specialists in photographs relating to the welding industry)

PLASTIC (Fireproof)

Welding materials.

PRESSURE GAUGES

The Bastin & Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
Superior Oxy-Acetylene Mach. Co.
U. S. Gauge Co.
United States Welding Co.
Universal Oxygen Co.

RAILROADS—Special Service for

Oxweld Railroad Service Co.

REGULATING VALVES (Acetylene)

The Bastin & Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
Federal Brass Works.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
F. C. Kuhnle & Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
The Prest-O-Lite Co., Inc.
United States Welding Co.
Universal Oxygen Co.

REGULATING VALVES (Hydrogen)

The Bastin & Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

REGULATING VALVES (Oxygen)

American Welding Co.
The Bastin & Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

SEAM WELDERS (Electric)

General Electric Co.
Westinghouse Electric & Mfg. Co.

SEAM WELDERS (Electric Resistance)

Thomson Electric Welding Co.

SPOT WELDERS (Electric Resistance)

Thomson Electric Welding Co.

TANK CONNECTIONS (Oxygen and Acetylene Adaptors)

Superior Oxy-Acetylene Machine Co.

THERMALENE-GAS

The Thermalene Co.

THERMIT WELDING

Goldschmidt-Thermit Co.

TORCHES (Gasoline and Kerosene Preheating)

Buffalo Dental Mfg. Co.
General Welding & Eq. Co.
The Macleod Co.
The Bishop-Babcock-Becker Co.
Metals Welding Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Westinghouse Electric & Mfg. Co.

TORCHES (Oxy-Acetylene Cutting)

Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Metals Welding Co.
The Macleod Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxvgen Co.

TORCHES (Oxy-Acetylene Welding)

Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
The Macleod Co.
Metals Welding Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Cutting)

Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Metals Welding Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Welding)

Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Metals Welding Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Special to Order)

Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Superior Oxy-Acetylene Machine Co.

TRUCKS (Cylinder Carriers)

Davis-Burnonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

VALVES (For Oxygen Cylinders)

International Oxygen Co.
Universal Oxygen Co.

WELDING (Electric Resistance-Custom Work)

Thomson Electric Welding Co.

WELDERS' GOGGLES

William C. Adams.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

WELDING (Oxygen for)

International Oxygen Co.
The Linde Air Products Co.
Universal Oxygen Co.

WELDING TORCHES (Oxy-Acetylene)

Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
The Macleod Co.
Metals Welding Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co
United States Welding Co.
Universal Oxygen Co.

WELDING TORCHES (Oxy-Hydrogen)

Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Metals Welding Co.
Oxweld Acetylene Co.
Oxy-Acetylene Products Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

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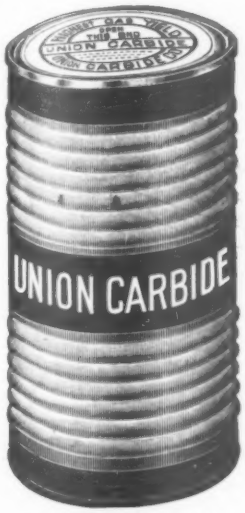

Packed in Blue and Gray Drums

Union Carbide Sales Company

New York City, 42nd St. Building — **Chicago, Ill., Peoples Gas Building** — **San Francisco, Cal., Kohl Building**

SOLE DISTRIBUTORS OF

UNION CARBIDE

"World's Best Quality—Highest Gas Yield"

For Oxy-Acetylene Welding Plants

Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

"Union Carbide" is packed in 100-lb. blue and gray drums marked conspicuously, "UNION CARBIDE."

The following sizes are carried in stock in 100-lb. drums:

$3\frac{1}{2}$ x 2 in. —a large size.

2 x $\frac{1}{2}$ in. —a medium size.

$1\frac{1}{4}$ x $\frac{3}{8}$ in. —an intermediate size.

$\frac{1}{4}$ x 1/12 in. —finely crushed size.

Union Carbide in the Generator sizes above listed will be shipped direct to consumers from a **Union Carbide Sales Co.** warehouse at any one of the following points where large stocks are kept on hand:

ALABAMA
Birmingham—1916 Morris Ave.
Mobile—262-268 S. Water St.
Montgomery—114 N. Perry St.
ARIZONA
Phoenix—16 S. Central Ave.
ARKANSAS
Fort Smith—109-123 So. Ninth St.
CALIFORNIA
Eureka—109 Second St.
Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—326-336 Fifth St.
San Francisco—Kohl Building.
COLORADO
Denver—Nineteenth and Wazee Sts.
Victor—Third and Diamond Sts.
CONNECTICUT
Hartford—877 Main St.
DISTRICT OF COLUMBIA
Washington—Maryland Ave. and 9th St., S. W.
FLORIDA
Jacksonville—106 E. Forsyth St.
Tampa—418 Tampa St.
GEORGIA
Atlanta—Cor. Haynes and Rhodes Sts., P. O. Box 1594.
Savannah—Ogeechee Canal, South of Bay St., P. O. Box 78.
ILLINOIS
Chicago—Peoples Gas Bldg., Michigan Blvd.
Decatur—133-147 W. Williams St.
East St. Louis—600 Walnut Ave.
Peoria—721-731 So. Washington St.
Marion—315 S. Granite St., Box 747.
Monmouth—601 S. First St.
Quincy—222 S. Eighth St.
Streator—702 East Elm St.
INDIANA
Evansville—1601 Illinois St.
Indianapolis—110-112 S. Alabama St.
Terre Haute—921 Wabash Ave.
IOWA
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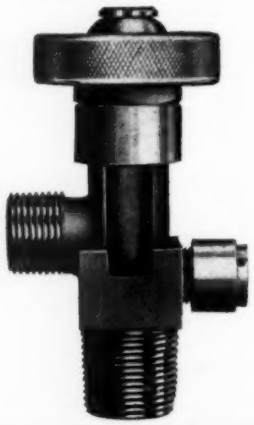

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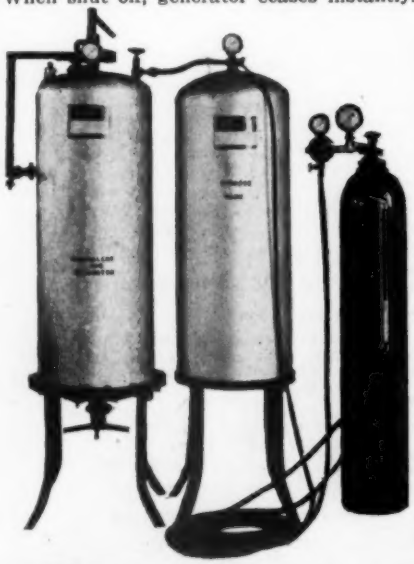

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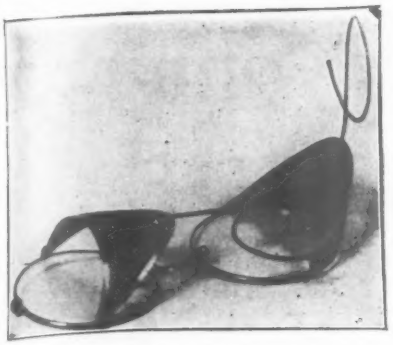

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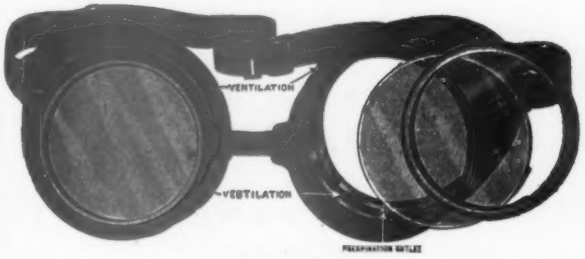

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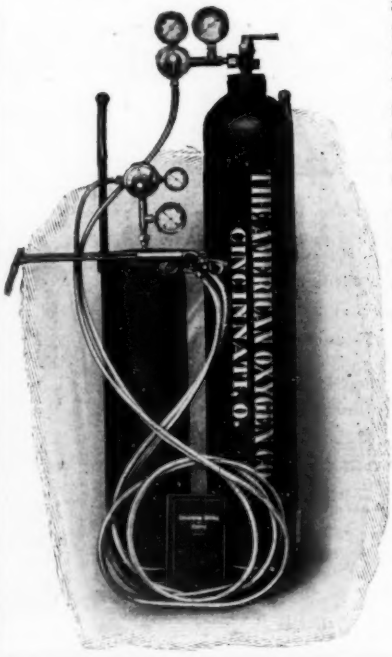

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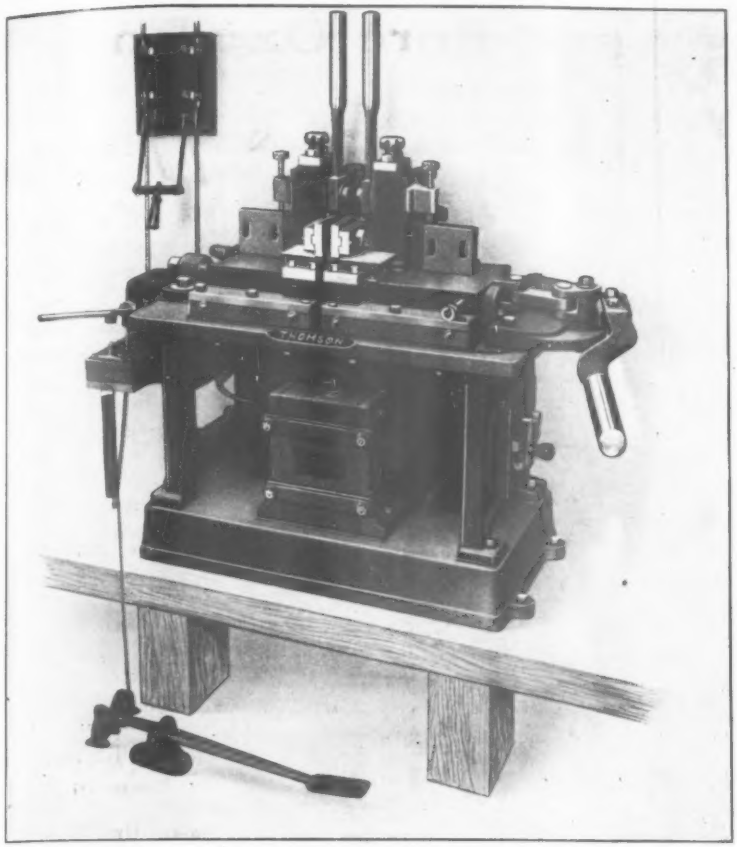

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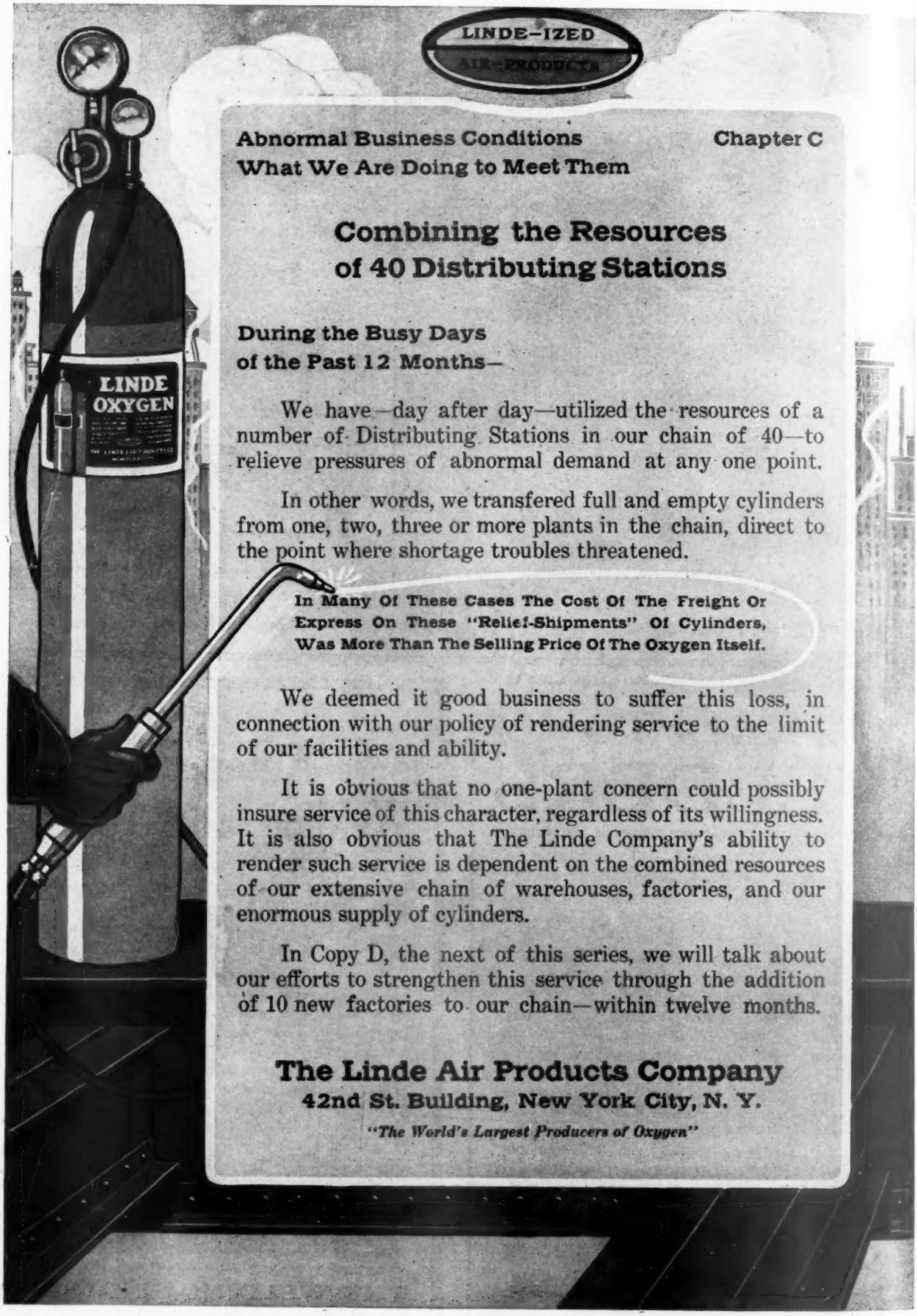

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Copies for office use	10
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VOLUME I. JULY, 1916. NUMBER 7

Welding Schools In England

IN a recent issue of an English trade paper we see no less than one dozen schools for welders advertised as being in operation in various cities in the British Empire. It is also known that such schools are being operated in France, Germany and other countries on the continent. It would seem that in this respect we have been rather lax in this country. Welders, like Topsy, have just "growed," in spite of us, and not because of us. Of course some of the larger manufacturers have always offered facilities for training men, but we believe these privately owned schools could hardly expect to be as successful as co-operative schools. Some action should be taken by manufacturers of apparatus and supplies to promote the cause of welding.

Welding Apparatus In The Army

CITY fire departments all over the country now have an emergency crew supplied with cutting apparatus. Quite frequently we hear of some one being rescued from a dangerous situation by means of a cutting torch in the hands of firemen. In our army we hear of wagoners, artifices, saddlers and mechanics of various kinds, but we have never heard that the engineering corps includes welders. Abroad the armies are making very good use of oxy-acetylene and electric welding apparatus, and it is to be hoped our officers who are observing the operations recognize the adaptability of these processes to armies in the field.

Does Writing for Trade Papers Pay?

THERE is a certain young man who gets an occasional new subscriber for *The Welding Engineer*. When this particular subscription-getter is told by a prospective subscriber that the latter does not feel that he can afford to take the journal, that he would not have the time nor the inclination to read, he tells the latter that by subscribing for the magazine he stands in line to get something for nothing, which generally awakens the interest of the prospective subscriber enough to ask for details.

He is then informed that any intelligent operator may notice, if he keeps his eyes open, things that are not too well known, but which would be of interest to others, and that by writing of these things he not only receives pay, but also has the satisfaction of knowing that he has rendered a service, even though it be slight, to other workers.

It is easy enough for the prospective subscriber to realize that once his interest in the magazine is gained by having an article of his accepted and paid for, he will begin to read more carefully what others will write, and puts himself in place of a critic, who soon learns to see things in a bigger light and finds a way to increase his usefulness.

Does writing for trade papers pay? Let the doubter give it a fair trial and then have his answer.

Learning To Weld

THERE are a considerable number of oxy-acetylene welding equipments in this country which are standing in disused corners of various kinds of shops—usually blacksmith shops. Instead of accumulating profits for the owner they are gathering dust and cobwebs only. This is true because the owners have not found it to be as easy to weld every sort of metal as they have been led to believe. We do not mean by this that the oxy-acetylene welding process is highly complicated and quite apt to baffle the skill of the ordinary mechanic. On the contrary we contend that any fair mechanic can become a fair welder if he will give proper thought and study to the subject. The man who expects to turn on the gas, however, and hold the torch to the fracture and produce a good weld is doomed to disappointment. Like everything else worth while, successful welding is the result of careful study and practice. The man who buys an outfit should not become discouraged and conclude that successful welds can only be accomplished by very experienced welders. He should grasp every opportunity to practice on odd pieces of metals of every sort and if possible he should spend a few days at least in a good welding shop in the nearest large city. Most manufacturers of equipments can arrange this. The man who is far sighted enough to do this will find a reward for his time and energy.

Welding On Railroads

AT their recent convention the Master Car Builders' Association discussed the question of welding cracked cast-steel truck side frames. The details of a committee report, together with the discussion which followed, is published elsewhere in this issue. Several members stated they were meeting with considerable success, while other members believe welds should not be attempted because fractures indicate a weakness in the design of the original casting. This committee needs the co-operation and advice of experienced welders, such assistance, for instance, as a high-grade welding association could give.

After the War

NECESSITY is the Mother of Invention. To the great war is directly traceable the wonderful impetus given certain American industries, and this is probably true of the welding trade. Some of these industries will necessarily suffer when the war closes, but we do not think this will be true of the welding industry. Stern necessity compelled thousands of manufacturers to look about them for ways and means of increasing shop efficiency, and when orders become harder to land it's the manufacturer whose shops are best equipped who will survive. Welding apparatus is a necessity, not a luxury, and the industry will most certainly expand.

Electric Arc Welding

A Great Variety of Work Is Being Done with Electric Arc Welding Outfits

Although probably most widely used in connection with railroad work, electric arc welding is rapidly finding many uses in machine shops, steel works, and in mines. With the severe usage, characteristic of the service in mines and smelters, the arc welding equipment should find many uses, and undoubtedly will form a very useful part of shop equipments in the near future.

All commercial arc welding is done with either carbon or metallic electrodes, taking power from constant current or constant voltage equipments. With carbon electrodes all kinds of work can be done, from the lightest up to work taking 1,000 amperes or more, the latter referring principally to cutting, as it is very seldom that more than 500 amperes can be used for even the heaviest welding. The metallic electrode welding may vary from 30 amperes, or even lighter, up to 200 amperes for the heaviest work. The consensus of opinion seems to be that the best grade of work can be done with bare electrodes without fluxes, but there are many advocates of the use of fluxes who state that many kinds of work, especially non-ferreous welding, require the use of fluxes.

In all classes of welding the test of the work is its quality, and the operator is largely responsible for the successful production of good welds. The generating equipment should be of ample capacity to maintain a steady voltage under the severe service imposed by this work, and so designed as to be free from sparking and overheating during severe overloads. The quality of the electrodes also affects the work directly, and in general the electrodes should be of smooth texture, free from irregularities of all kinds and of uniform chemical composition.

Fig. 1—Hole in gear case ready for welding.
Fig. 2—Patch welded on gear case with electric arc.
Fig. 3—Defective bottom plate in compound kettle.
Fig. 4—Compound kettle with electric arc. Defective plate cut out; new plate ready for welding.
Fig. 5—Compound kettle, new section of bottom plate welded in with electric arc.
Fig. 6—Annealing box showing burned in corner, rivet heads burned off and plates sprung apart at the joints.
Fig. 7—Annealing box showing rivet heads built up, gaps at joint filled in and patch welded on corner by the electric arc.
Fig. 8—Tanks electric arc welded. Shell stock ⅛ inch. Base stock ¼ inch.
Fig. 9—Two-inch tubes electric arc welded in ¼-inch boiler plate, showing battered tubes. No oil leaks produced.
Fig. 10—Two-inch tubes electric arc welded in ¼-inch boiler plate, showing welds and battered tubes. No oil leaks produced.
Fig. 11—Gear case suspension lug repaired with electric arc.
Fig. 12—Broken gear case suspension lug.
Fig. 13—Plating tank and radiator electric arc welded tank 96 inches by 36 inches by 24 inches. ¼-inch stock, ¼-inch by 1¼-inch angle iron.
Fig. 14—Broken taps removed by arc welding.
Fig. 15—Smoke stack 3/16-inch boiler plate electric arc welded joints.
Fig. 16—Section of a smoke stack. Seams welded by electric arc welding process. Metal ¼-inch boiler plate.
Fig. 17—Type MPC 8-550 H. P.-580-550 volt S. W. Hoist Motor.
Fig. 18—600-amp. arc welding and generator control panel.
Fig. 19—Generator direct connected to motor, forming a three-bearing arc welding set.

An up to date arc welding equipment consists of a compound wound direct current generator designed to operate at some constant voltage from 60 to 75 V. and arranged for any standard method of driving. The main control panel is usually provided with a welding circuit of full capacity of the equipment in addition to the customary field rheostats, instruments, etc., and each auxiliary welding panel is provided with a simple equipment consisting of control rheostats and automatic device for protecting the generator and the work in case of short circuit due to accident, or carelessness on the part of the operator.

Equipments have been standardized by the General Electric Company in capacities of 200, 300 and 400 amperes for portable work, and in capacities of 200, 300, 400, 500, 600, 800, 1,000 and 1,250 amperes for stationary work. While the small sizes are generally designed for one operator only they can be used for more operators if the work is of a sufficiently light character, in which case the number of operators can be increased up to the capacity of the equipment, and this latter condition holds good for all capacities. In this connection it is interesting to note that for certain classes of work there seems to be a definite movement toward installing large numbers of single operator equipments instead of using large machines and a number of auxiliary panels. This movement seems to be based on the high cost of necessary heavy wiring work, where leads must be carried long distances, and where only light work is to be done, it is obviously advantageous to allow each operator to have full control of the volts and amperes for his particular work. One of the disadvantages of having a large number of small machines is encountered where heavy welding or heavy cutting is to be done, in which case the single high capacity equipment is much superior.

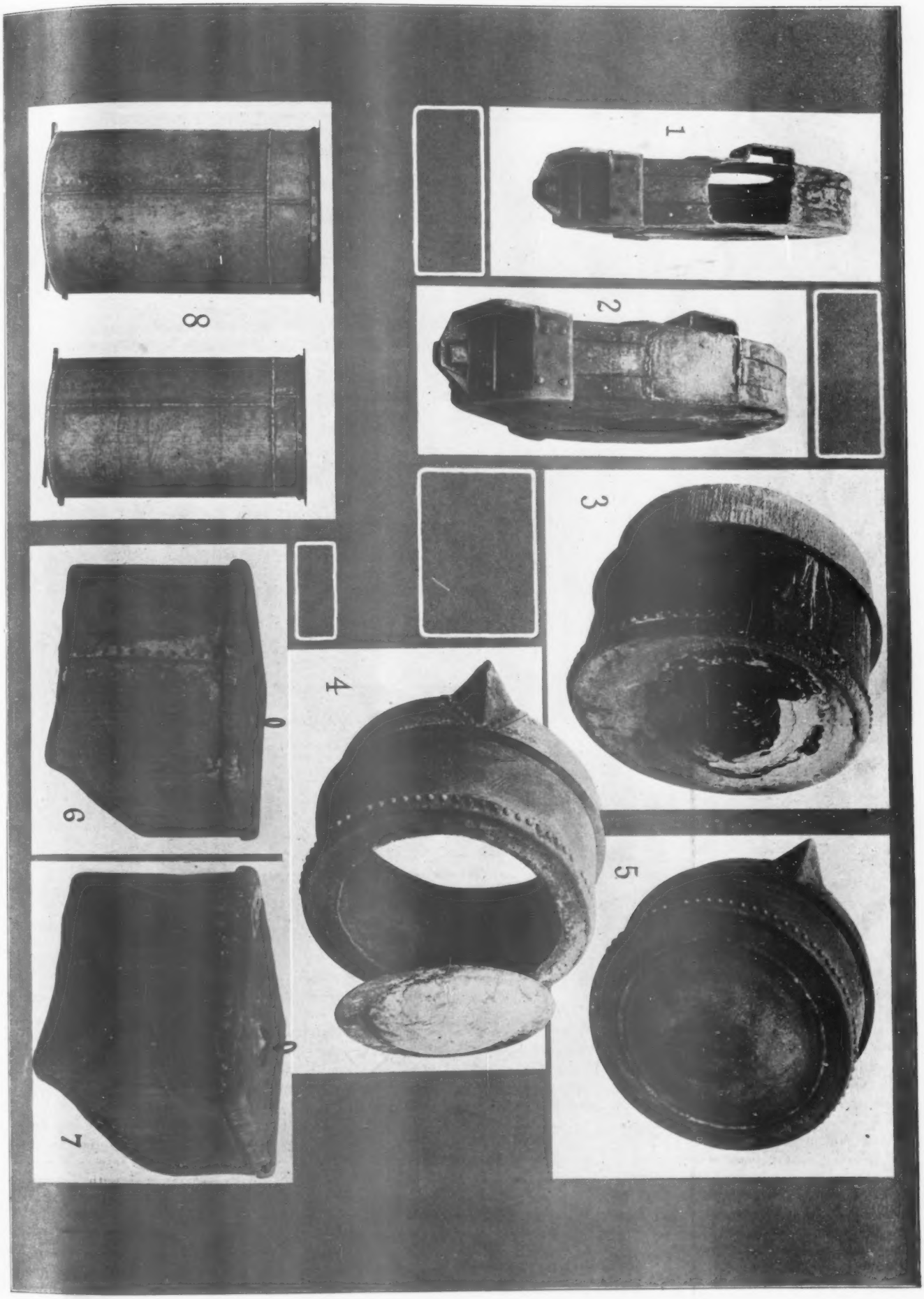
With the constant voltage equipment a series rheostat is provided to vary the current supplied the arc and this variation is accomplished by cutting in and out various parts of the rheostat by means of a dial switch. In many installations no automatic protection is provided, but it is believed that the slightly increased complexity caused by adding this device is well worth the added investment, on account of the insurance against error. Mistakes are inevitable, and there is a considerable loss of efficiency when it is necessary for the operator to walk even a short distance to restore the circuits to normal operating conditions, and the loss is considerably greater if several peaks should come at one time, in which case the entire circuit might be shut down for an appreciable period.

With a good automatic equipment the circuit will be broken as soon as the operator exceeds the current for which the equipment is set, and the circuit will stay open as long as the operator holds the electrode on the work. As soon as the circuit is broken a small relay returns the circuits to normal operating conditions, without loss of time or inconvenience to other operators. If desired, a preventive resistance can be inserted in the line instead of breaking the circuit, and this resistance can be put in series with the arc before striking, in order to prevent the initial rush of current sometimes taken by an inexerienced operator.

The relays and contactors above referred to are clearly shown in Figs. 17 and 18, the first figure showing the arrangement of the portable equipment. These are designed to stand up under the severe service met with in ordinary shop work, and as is evident, makes a very compact arrangement.

In Figs. 18 and 19 are shown the control panel and motor gnerator set respectively for the 500-ampere equipment, this arrangement being characteristics of the stationary outfits.

One source of extreme trouble in many shops is the break-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ing of taps in the work, which frequently results in scrapping the part affected. With the arc welding equipment it is a simple matter to remove these taps, and the total time will vary from 4 to 10 minutes, depending upon the size of the tap and location of the break. When the break is below a certain distance from the surface of the work it is advisable to weld through a piece of pipe, which is placed in the hole before starting the weld, and by such means 1 in. taps broken off 2 in. below the surface have bee nremoved without injury to the thread.

The life of a compound kettle at one time was determined by the appearance of a depression in the bottom plate, which would bag and then burn out, after which the kettle was scrapped. The kettles are now removed from their settings, the bottom plate partly cut out, and we obtain practically a new kettle by welding in a plate from stock that is kept for this special purpose.

Figs. 3, 4 and 5, show a kettle before and after this treatment.

The annealing of laminations for electrical machines must

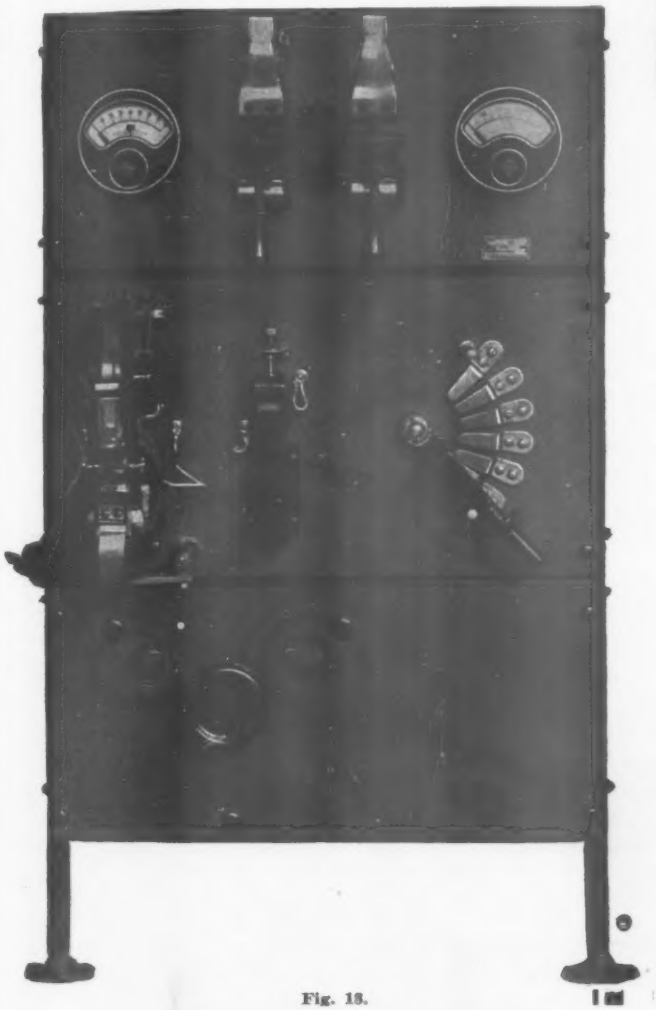


Fig. 18.

be done out of contact with the air, and the containers are subjected to the severest kind of treatment, which results in their depreciating very rapidly. In Figs. 6 and 7 we have one of these boxes which has the plates sprung apart at the joint, on account of the rivet heads being burned off and a hole burned in the corner, all of which was easily repaired soon after the operator started work.

It is well known that street car equipments meet with hard usage, and in Fig. 11 we see a gear case suspension lug practically as good as new after being welded in position. Occasionally a gear case will drag on the pavement and be worn through, shown in Fig. 1, and it is a comparatively simple matter to cut away the hole and make the gear case ready for service, as shown in Fig. 2.

In the heavier work of steam railroading we meet one of the most important applications of arc welding, and one of which is meeting with the best of success. This is the welding of tubes in locomotive flue sheets, and in Figs. 10 and 9 we have a section of a standard locomotive flue sheet

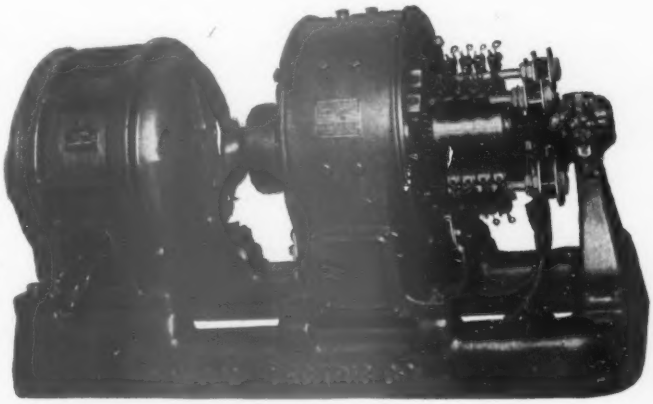


Fig. 19.

with the tubes ready for welding and after welding respectively.

In the still heavier work around steel mills, there are many places where the arc welding equipments will return enormous dividends every year.

When a steel roll wobbler is worn it is dangerous and of little value, except as scrap, and it is interesting to see how the worn parts can be built up by arc welding, and what a saving in labor and material the wobbler can be made as practically good as when manufactured. It is obviously impossible to illustrate even a small percentage of the many things that can be done by arc welding, and these few ex-

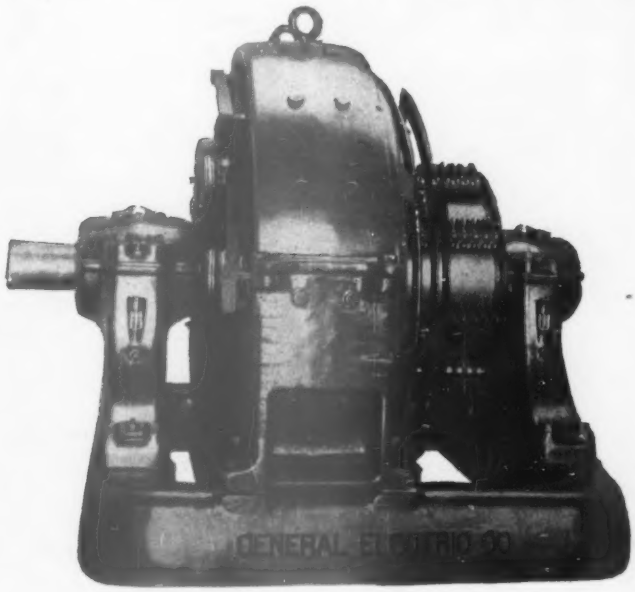


Fig. 17.

amples are presented more as an indication of what has been done rather than as an attempt to list all the possibilities of these equipments. Also these examples indicate what can be done in repair work, and practically nothing has been shown of the possibilities in regard to primary manufacture where many of these equipments are operating very successfully in

welding all kinds of steel shapes for various manufacturing purposes. The speed and safety of these equipments, as compared to other types of welding equipments is especially notable, and it is doubtful if there are any other applications of electricity that are more useful and interesting than this.

Oxy-Acetylene Welding of Cast Iron.

By B. Kopferschmidt

Cast iron, known as that iron which is produced by a blast furnace, contains carbon, phosphorus, sulphur, silicon, manganese and other elements. It is brittle, fusible, and melts at 1,150 degrees Centigrade.

There are five different grades of cast iron, but there are only two that the oxy-acetylene welder is mostly concerned with. One grade, known as grey cast iron, has a dark, open grain, and contains carbon in its free state, thus making it soft and easy to work. The elements making up this iron and their percentage are as follows: Iron, 92.37; graphitic carbon, 3.52; combined carbon, .13; silicon, 2.44; phosphorus, 1.25; manganese, .28, and sulphur .02.

The other grade, know as white iron, is combined with the carbon, and causes the metal to become very hard and difficult to work with.

This kind is mostly used in the rolling mills, and cannot be successfully welded. The percentage of iron in this is 94.68, graphitic carbon 0, combined carbon 3.83, silicon .41, phosphorus .04, maganese .98 and sulphur .02.

The state of the carbon in cast iron determines the quality of that grade of iron. If the carbon is combined with the iron in the form of an alloy, a hard, brittle, white iron is produced. If its presence is merely as graphite, distributed as small particles through the entire mass, the iron is soft and grey in color.

The amount of silicon introduced in cast iron, in the form of ferro-silicon and the rate of cooling determine the proportion of graphitic to combined carbon in the casting. Increasing the amount of silicon in cast iron increases the proportion of graphitic carbon, thus making that iron softer; a large quantity of silicon, however, will tend to stiffen and weaken the iron.

Manganese, on the other hand, increases hardness and shrinkage, making the iron more brittle, and leading to white iron.

Phosphorus, in general, weakens cast iron, but it is not harmful if less than 1 per cent is present. The benefit derived from phosphorus is the decrease of shrinkage and an increase in fluidity.

Sulphur tends to make the casting hard and unsound, also will tend to prevent from flowing well. The amount of sulphur should not be over .5 per cent.

In order to comprehend thoroughly the cast iron welding it is necessary to make a brief survey over the former methods for repairing broken castings.

The oldest method employed was the mechanical way. A patch was applied with rivets or bolts. But the drilling of holes usually weakened the casting, and the operations in many cases were considered as too expensive and as a temporary measure.

The second, and more advanced method, was the brazing process, invented by a German metallurgist in 1889, and adapted in this country by Mr. Ferrofix in 1903.

The brazing of cast iron requires more skill and a greater intensity of heat than the oxy-acetylene process and when performed right, especially in heavy castings, will give better results than when welding them. The fuel for brazing cast iron is limited only to natural gas or artificial gas, combined with compressed air in suitable burners, with adjustable stands and projected on to the metallic parts to be brazed.

Brazing of cast iron necessitates the use of a fire brick furnace, the shape and size of which would depend on the casting, with holes left open to allow the flame of the burners to heat the casting and furnace.

At the beginning the flames are small, with but little air, then gradually the flame is made stronger, until the desired cherry red casting is obtained. At this point a cleaning flux is applied to the fracture or break with a long spoon, allowing it to penetrate throughout the casting. Then brazing spelter, a composition of copper and zinc, is applied with the same spoon. The brazing metal melts and adheres to the edges to be joined, and the joining is accomplished simply by slow cooling. On account of the high temperature in the furnace lump brazing metal is preferred to grain.

Even to the present day it is taught in certain schools that cast iron cannot be welded, yet oxy-acetylene welding of cast iron is a known art since 1900, and, like other inventions, it went through a slow progress to bring the process to its present state.

It is a well known fact that oxy-acetylene blowpipes were not applied successfully, immediately after their introduction, to the welding of cast iron. Any attempt to weld cast iron at that time was met with failure. One common complaint was hardness; another was that it broke on heating or contracting. Even today in certain shops a good cast iron weld is looked upon as unreliable.

As a matter of fact, the welding of cast iron is the easiest of all, and the one that gives the best results, and if one could follow the proper methods the insurmountable complaints of hardness and breaks on contraction could be easily overcome.

The obtaining of soft welds of grey cast iron depends on the state of the carbon in it, and in order to accomplish such a weld it is necessary to facilitate the precipitation of the carbon in the form of graphite. This can be brought about by slowly heating and cooling the casting. Rapid cooling of the metal in fusion will tend to bring about the combination of the carbon and the iron, and thus lead to the formation of white iron. Hence the hardness on the welding line.

Another method, employed to obtain soft welds, is the introduction of a proper amount of silicon in the cast iron welding rod, which tends to alloy with the iron and causes it in some way to take the form of graphite and thus to facilitate the formation of grey iron at the welding line. If, however, some old cast iron pump rings are used as welding rods, the presence of manganese in it will cause a hard and weak welding line.

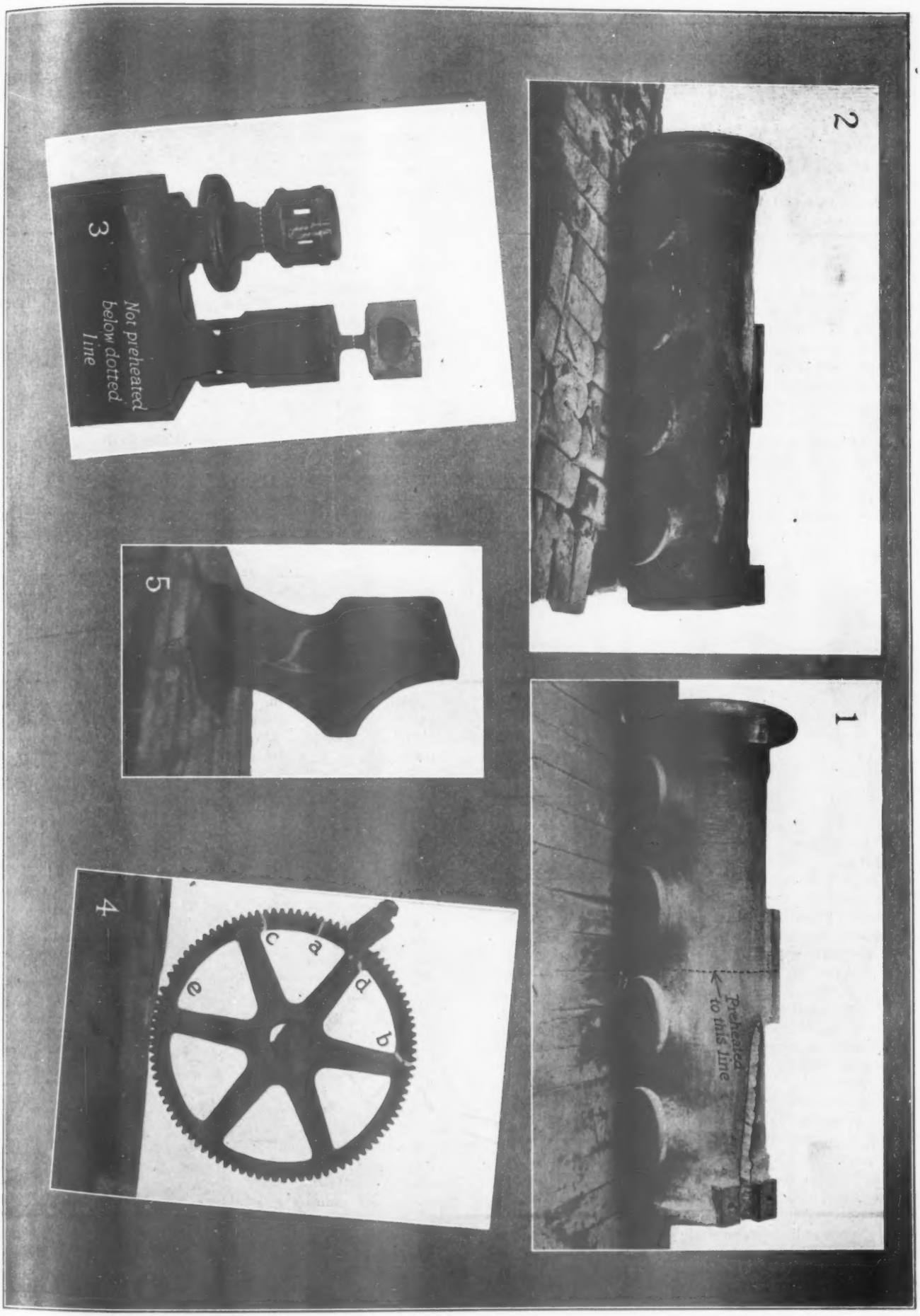
As was stated above, the melting point of cast iron is 1,150 degrees Centigrade, a temperature at least 300 degrees Centigrade lower than the melting point of iron. On heating the cast iron the iron of the metal will form an oxide with a melting point at 1,350 degrees Centigrade, which tends to prevent the combination of the molten metal and also burn the carbon, thus we have again the formation of white iron. It, therefore, becomes necessary to destroy this iron oxide, which is less fusible than the metal. This can be accomplished by applying a cleaning flux in the form of a powder, by means of a hot welding rod.

An improper welding flame will also bring about the formation of white iron. To avoid this a larger tip may be used than it would be required to weld steel, the same thickness, and the flame of which should be neutral.

A neutral flame has a white, greenish jet and is uniformly round. An oxidizing flame has a white bluish jet and is thinner. The addition of a little more acetylene in this case will bring the flame neutral.

A decarboninzing flame has a long white, greenish jet with a bluish shade at the point. A little more oxygen will bring it to a neutral flame.

To prevent the casting from breaking on heating or con-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Preheated to this line
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Not preheated below dotted line
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tracting, due to the lack of elasticity, it would be necessary to examine the parts of the casting to be welded and those adjoining. If there is an opposition for free play of the metal when it is heated or cooled it becomes absolutely necessary before commencing to weld to preheat the whole or part of the casting in a charcoal oven made of fire bricks, to suit the casting on hand, and heated until a cherry red heat would be attained. After welding the cooling must be very slow. To do this the oven is covered with sheet asbestos and let stand until the bricks are cold.

For castings that have free play of the metal on heating and cooling it is sufficient, after the weld is done, to play the blowpipe flame on the part heated, so as to anneal the welding line, and then to cover with sheet asbestos, to insure slow cooling.

The preparation of welds are simple. The edges of the weld should be beveled, if the thickness exceeds ⅛ in. The parts to be welded should be tightly secured in line, so they should not move before it is joined, while the base of the welding line should be of fire bricks or carbon blocks.

If the above precautions are taken the execution of the welds present no special difficulty. The blowpipe is played on the edges to be welded until the iron melts on both edges at the same time. As soon as the first fusion is obtained the welding rod, powdered with some cleaning flux, is applied, and the base will join with its own metal. Then the melting of the welding rod should take place, as much as possible in the molten bath, and the flame played all around, until the desired height is reached. The main precaution to be taken is to avoid currents of air during the welding. The white jet of the blowpipe shou not come in contact with the metal, but be kept at a ance from ¼ in. to ¾ in., according to the thickness, and n llow the metal of the rod fall drop by drop or to hold it far away from the molten bath.

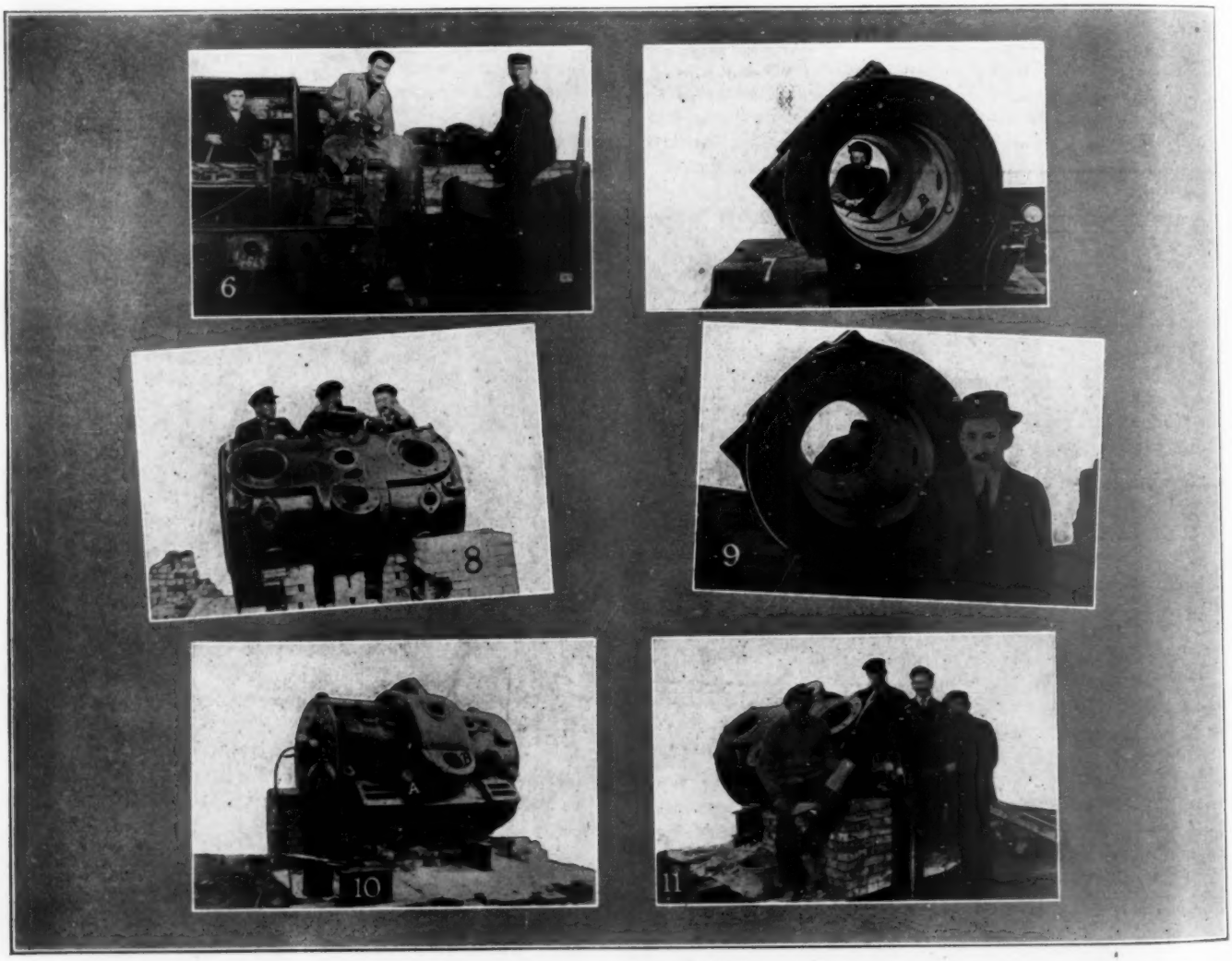
Applications

The applications of oxy-acetylene welding to ca iron really have no limit. To mention what may be done, how far its possibilities can be stretched would be an dless task. I shall, therefore, try to limit my examples t a few types or more or less complicated welds that hav come under my direct supervision:

Fig. 1 shows a water feed pump cylinder, simple plex, with a 28 in. crack lengthwise, and 1 in. thick.

Fig. 2 shows the same cylinder restored and fully as serviceable as a new one. It was tested to 300 lbs. pressure. In the case of this cylinder it was necessary to bevel the edges to a 45 degree angle with an air hammer. Then about half the cylinder was preheated in a brick furnace.

In building the furnace place one row of bricks on a welding table, large enough to make an ample platform for the furnace. Then build brick walls all around the cylinder, leaving 6 in. for fuel displacement. The first row of bricks should be set, leaving 1 in. distance between the bricks for draft purposes. The bricks in the following rows may be placed close together, as in building formation. The height of the furnace above the crack did not extend more than 3 in. Then the furnace was completely filled with charcoal, and with the use of a welding blowpipe the fuel



was kindled through each of the bottom holes left for that purpose. After the fire was well started the furnace was covered with sheet asbestos, and at the end of three hours the cylinder was cherry red and ready for welding. The asbestos covering was then removed at the crack only, and welding was begun from the end. Care was taken that enough material was left at the surface of the flange that it might make a bearing for the cylinder head.

At the end of the welding operation a little more charcoal was added, and the heating was continued until the desired cherry red was obtained. Then all the draft holes were closed with fire clay and tightly covered with sheet asbestos. It was left to cool 26 hours, at the end of which time the cylinder was ready for test.

Left cut of Fig. 3 shows a separate exhaust valve, while the right one is an intercepting valve of a compound locomotive. The cost of these valves, when new, is $100, while the cost to repair them by the oxy-acetylene process was $1.75.

Left cut of Fig. 3 had a 3 in. hole that ran through the casting. On preheating the 3 in. hole was plugged with fire clay at the end of the furnace, so that the heat should be saved at the preheated portion.

These castings, after beveling, were preheated only to the dotted lines shown on the figure. After one hour heating the casting was cherry red, and was ready for welding. The welding operation was then gone through, and then was allowed to cool for 10 hours. The casting after that was ready for dressing at the seat and ready to take its place on the locomotive.

Fig. 4 shows a welded gear wheel that was broken at A, B, C, D and E, on the figure. In this case the two rim pieces were put together in the fracture and tagged strongly between the teeth. Then it was beveled on the opposite side and welded, without preheating, at A. The next operation was to clamp the welded piece of rim into the gear, as shown in figure, but when the welder finished that weld the piece at C did not fit. On heating the welded piece of rim at A the teeth drew towards the flame, and finally reached back to its place at the fracture. It was then beveled at B and C from the inside, and at A from both sides of the spoke, leaving about ⅛ in. or ¼ in. solid metal. After tightening the clamp the spoke was welded at D by tagging a little on one side and then on the other. The wheel was then turned over and welded completely, on both opposing sides.

The next weld was at C, but before commencing to make this weld two blowpipes were used in the preheating operation, in order to cause expansion of the spoke at C and B.

When the parts were cherry red the weld was performed rapidly at C, while the other blowpipe was playing around the spoke at B. Immediately after this the weld at B was performed, while the other blowpipe kept the C and D spokes to a dull red. When finished all heated portions were covered with sheet asbestos and left to cool.

In building up the tooth at E a small brick furnace was built around the rim and heated with charcoal for about an hour. The tooth was then built up on the rim and trimmed off with the blowpipe to the size required. This can also be accomplished by fitting carbon blocks on the sides to the required size of the tooth.

Fig. 6 shows a locomotive main steam pipe, with two broken lugs at the flange. In this case carbon blocks were placed under the lugs, and more blocks, the same thickness as the flange were ground to the same shape as the broken lugs, thus forming a sort of mould. The carbons on the other side were securely clamped so they did not move during the welding operation. Then the blowpipe was played at the broken edge until it reached a bright red. Then the spaces were filled with a ⅜ in. or ½ in. cast iron rod until the surface of the flange was reached. Care was taken that the joining of the metal, next to the fracture, should be perfect.

The heated portion was then covered with sheet asbestos and allowed to cool.

Another method of building up such lugs would be by setting the flange verticle and to build up on top of the fracture little by little until the desired size is reached. The surplus metal can be easily trimmed off with the blowpipe. This method requires more time and material. The first method required one hour of labor, about 34 cu. ft. oxygen and 30. cu. ft. aceytlene. In the second case it required 5 hours' labor, about 112 cu. ft. oxygen, and about 100 cu. ft. acetylene.

Fig. 7 shows one 540 horsepower gas engine cylinder with 3 jackets, 1¼ in. thick, and weighing about 6,500 lbs. This cylinder was cracked at three places: A, B and C on the inside jacket. The A crack ran from the port hole about 12 in. in length; the B crack ran all the way through the port hole, while the C crack ran all around the cylinder. After all the cracks were beveled to a 45 degree angle, a fire brick furnace was so constructed all around the cylinder that the cylinder could be turned with the aid of a 5-ton chain hoist overhead. The fuel to preheat this cylinder was natural gas. Fig. 7 also shows 6 burners specially made for the preheating purpose. These burners were placed in such positions that they would give a uniform heat all around the cylinder. At first the flames of the burners were small, but were gradually increased. At the end of 11 hours the whole cylinder was a mass of cherry red, and the burners were all stopped, no compressed air being used with these burners.

The first weld was made at A without turning the cylinder. Two more hours of heating was allowed, when again the burners were stopped and the cylinder turned so the crack at B should be in a vertical position. The metal was built up at the side crack from the bottom up, until the surface was reached. Again the burners were applied and the welding of C was begun. In making this weld it required to turn the cylinder four times, and to reheat it after every turn. Then the draft holes and crevices that were found open were closed with fire clay and allowed to cool for 50 hours.

At the end of that time the furnace was removed and the casting chipped and filed. The cylinder was then ready to be placed on the engine. For this work a long-handled water-cooled blowpipe was necessary.

Fig. 8 shows the cylinder lengthwise, and the brick supports under the cylinder, made before building the furnace, so as to prevent setting.

Fig. 9 shows cylinder already welded and furnace removed.

Fig. 10 shows another cylinder of like type cracked on the middle jacket at A and at the porthole at B. In this instance a hole was cut out at A at the outer jacket and the edges beveled. The internal crack, about 6 in. long, was beveled on the middle jacket.

At B the pieces were broken off and lost, so that another piece of cast iron was cut and beveled to fit the hole. The same methods were employed in this case for building the furnace and preheating as in the above cylinder.

When the cylinder was cherry red the internal crack was welded first, and then the piece cut out. In the latter case a ⅜ in. cast iron rod was welded on top of the piece cut out, to facilitate handling, and then welded on to it. The cylinder was then reheated for about an hour and turned for the patch, B, which made the last weld. After 50 hours of cooling the furnace was removed and the cylinder was ready for service.

Fig. 10 shows the cylinder welded and the furnace removed.

Fig. 11 shows the beginning of making the furnace.

Hints for the Welder

Practical suggestions from practical men. Contributions to this department solicited.

RECLAIMING AN OLD PATCH

Accompanying sketch is of a patch around fire door of a locomotive boiler. There are a great many patches of this nature on locomotive boilers throughout the country today, this being the only way to keep the engine in service without renewing the door sheet after the flange around the door hole has become badly cracked. As every practical boiler maker knows, the life of these patches is very short on account of calking edge becoming fire cracked and patch bolts getting loose below the fire door, and after a few clippings and calkings it becomes necessary to renew a great many of the patch bolts in the lower section or under the fire door. Now I am handling these old patches with the cutting and welding torches. Fig. 1 is sketch of a job I recently did

Fig 1

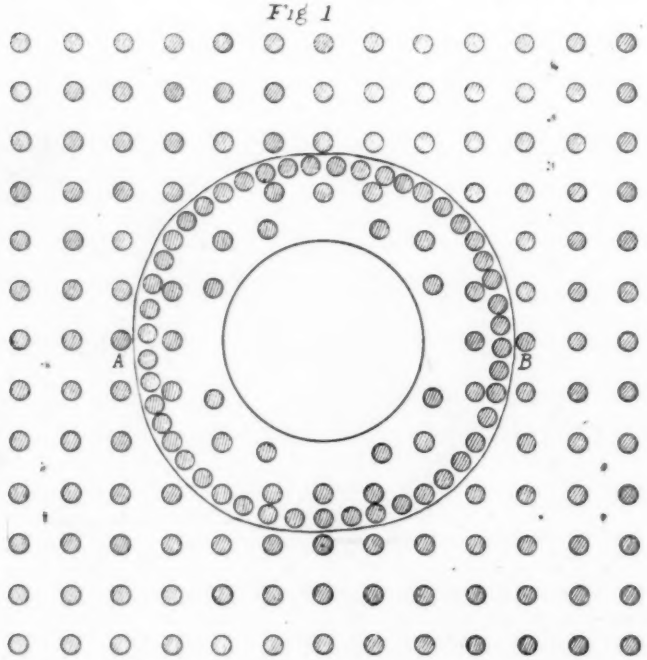
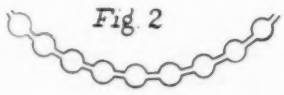


Fig 2

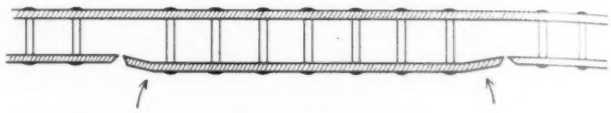


Method of Reclaiming Old Patch.

with one of these patches. From A to B, Fig. 1, patch bolts were loose and calked so much that the heads were about worn away and calking edge burned and calked away. In fact the patch was in such a condition from A around under the fire door to B that it was impossible to use the engine. With cutting torch I cut out patch bolt at A, getting an opening or starting point, then cutting through the patch bolts and both sheets a narrow slot around it to B, then cut off the lap parts of both patch and door sheet at points A and B and knock out what is left of the patch bolts. This leaves an opening like Fig. 2. Now I chip off all oxidized iron left by the cutting torch. As the patch lapped over the door sheet at seam, Fig. 3, there is an offset in the opening to be welded, but by heating patch along edge of opening I can knock it back in line with door sheet, Fig. 4. By using welding torch with a large tip for heating

Fig 3

Fig 4



Method of Reclaiming Old Patch.

edge of patch it only takes a few minutes to get edge of patch in line with edge of door sheet. Of course this is an unusually large opening to weld, but it is a great saving in time over any other way of making permanent repairs on an old patch of this kind. W. T. F.

A 4-CYLINDER CONTINENTAL ALUMINUM MOTOR.

Editor: Two arms were broken off upper case. No. 1 end was broken through cam shaft bearing A, stud lug B was broken out and arm was cracked at C, and broken from D to E along zigzig line. Side view shows break through cam shaft bearing.

No. 2 end was broken along zigzig line from F to G. This was welded first by being clamped into position by a bar on the outside face, and one on each side of the bottom. A bar was also clamped on the cylinder base to keep face in line. Tacked at G.H.F. and after playing blowtorch in vicinity of break about 10 minutes welding was started at G and finished at F. While this was cooling, crack C on No. 1 end was completed. No. 1 end was then set in place and a piece of angle iron was clamped on faces C, No. 1 and I, No. 2, to keep the arms square, as that is the part which rests on the frame and it is very essential that they be perfect.

A bar was clamped on outside face and on bottom. Tacked at D and E. Then B was backed in place. After playing blowtorch on this part for about 25 minutes welding was started at D and completed at E.

Blowtorch was kept on casting during entire welding operation and no moulds were used, as the entire break was welded from both sides. When finished every part lined up true. Job completed by one man.

Cover which fits on No. 1 side has several holes broken out, and the lower half had several broken out and two good sized corners broken out. When finished 2 holes required drilling. The others were saved by putting a piece of steel the correct diameter in the broken hole and building metal around. Welding was done at the rate of about 3 or 4 inches on the outside, then turned and finished on the inside, and so on.

I always use a fairly good size tip with excess acetylene because successful aluminum welding must be carried out rapidly. By using a ragged white cone about 2 or 3 inches long it allows the operator to make a very smooth workman-like job with the paddle, as the metal is controlled more easily.

Another trick worth knowing is: while digging out the break, and while welding, the operator will get the paddle red hot and often bring it to a white heat unless very careful. This causes oxide to form on the paddle, which will readily incorporate with the aluminum, causing much trouble. To offset this difficulty I keep a pot of water at hand and dip my paddle every time it starts to get red, and also stick my rods in. Then when I pick up a rod I don't have to worry about getting burnt. This feature I think every successful welder will be glad to copy, because it will be noted that aluminum can be puddled far more successfully with a cold paddle than with a red hot one. I might also add that I rap the paddle sharply against the table to dislodge the oxide before dipping.

B. J. Lheid.

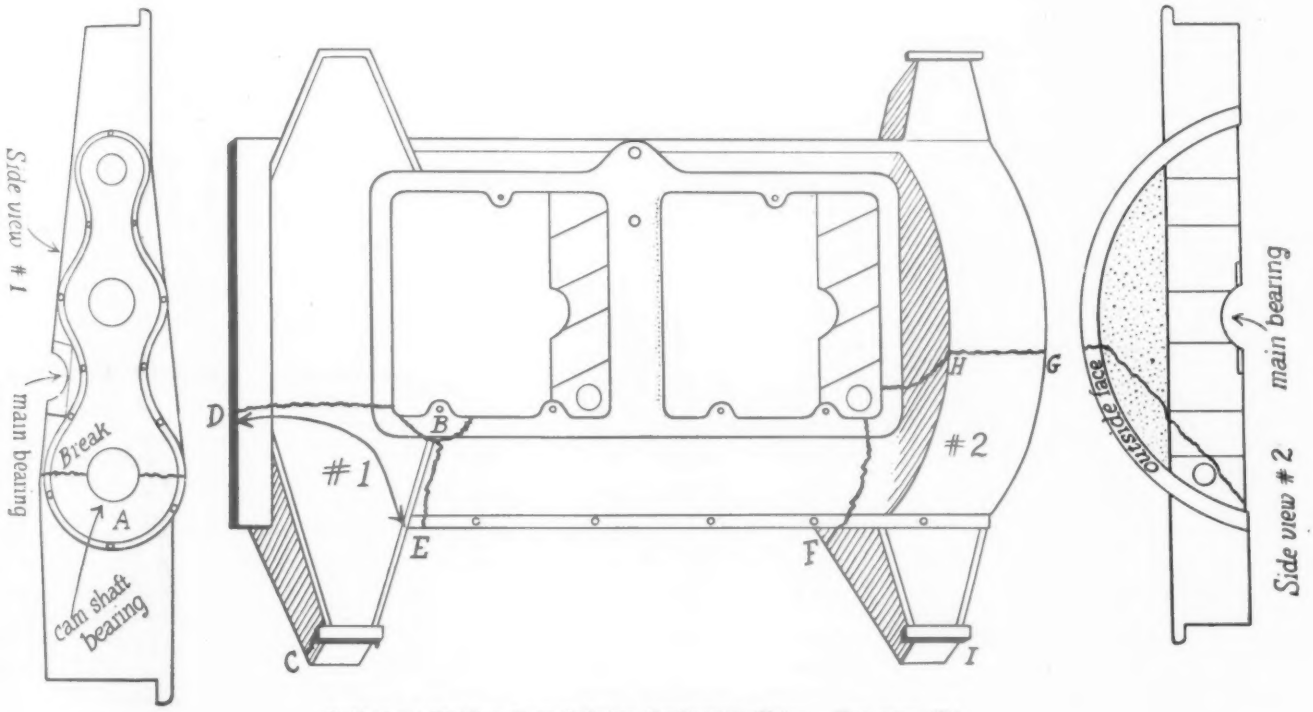
head. The darker the glass, the better for welding; light blue glass will be found satisfactory for cutting.

Then comes the welding table; do not use some old rickety stands, blocks of wood, or boxes for the table stand. With the aid of the welding blowpipe, one may make a welding table entirely of metal, with very little expense. On page 29 of the June issue you illustrated a welding table made in three hours. For production or repair work, this table, with seats and drawers combined, will give the best service; the seats can be adjusted with a set screw to suit the work, or they can be turned under the table.

Fire bricks and fire clay should always be in abundance in a welding shop for building preheating furnaces; sheet of asbestos, asbestos gloves and carbonized blocks, are also important factors, and when lighting the blowpipe one may not use a match, as it is unsafe, nor a gas jet as it is expensive and stationary, but a gas lighter will produce both safety and economy.

At last one may not forget to install in some corner of the shop a fire extinguisher and boost safety first.

B. Kopferschmidt.



Method of Welding Four-Cylinder Continental Motor. **(See page 26.)**

MODERN TOOLS FOR WELDING SHOP.

Editor: An oxy-acetylene welding shop may vary in size from the single welding blowpipe to a great establishment fitted with welding machines and many welding and cutting blowpipes, fires and furnaces.

The most important tools in a welding shop are the welding blowpipe and the reducing valves. An efficient blowpipe should be as safe as possible, easy of adjustment, easy to direct and possess stability of flame.

The reducing valve or pressure regulator should have two gauges, one to show the tank pressure, the other to regulate the pressure for the blowpipe. The oxygen pressure through the reducing valve should be constantly and automatically regulated.

Then comes the flexible tubes or hose, and these should be of good rubber, three-ply tubing, about 10 or more feet long and clamped with small clamps to the connections.

Next is the goggles with an aluminum frame, air holes at the sides and a rubber band to be adjusted around the

New York, June 26, 1916.

Editor:

Was very much interested in article appearing in current issue of *Welding Engineer*, signed by P. A. E. Armstrong, and in view of the fact that my experience does not exactly correspond with the experience set forth in said article, I take this opportunity to call attention to certain discrepancies between the writer's statements and my personal experience.

First of all, it seems to me that the point regarding overheating the steel is poorly taken. The knowledge we have of overheating or buring of steel has been gained mostly in metallurgical practices, which involve use of steel that contains an appreciable amount of carbon, a good deal more than is at present considered good practice to employ in welding pencils. Furthermore, the harm done by overheating is not by any means entirely dependent upon the temperature to which the metal is heated, but also upon the rate of cooling.

To begin with, if it is merely a matter of temperature, any fusion welding process is bound to produce a zone of metal

which, according to Mr. Armstrong, is "irretrievably spoiled" because, if we consider a section of any weld and the metal adjacent thereto, the temperature somewhere outside of the weld must be at a point far below the melting point of the metal and within the weld above the melting point. Therefore, between these points there is bound to be a section that is heated just under the fusing point, no matter what process is used, gas or electric.

Practice does not bear out the statement that this metal is "irretrievably spoiled."

About the method of welding employed, the sketches showing what is termed "bare wire" welding do not indicate what we consider modern and good practice in bare wire welding. In fact, we have been employing the multiple string method shown in Fig. 6 of said article for almost 10 years, and have had no trouble with cracks and temperature strains. It is well known that every form of electric arc welding melts metal very rapidly, and therefore uses a minimum amount of heat to accomplish the result. The effect of this is to cause extremely rapid cooling of the metal, leaving practically all the strains in the metal itself. To put on an excessive amount of metal, such as shown in Figures 2 and 4 of said article, would be ridiculous, because this mass of metal is not necessary to make a weld, and the only effect would be that the contractive force of the mass would exert an excessive pull on the parts welded, and result in a strain or an actual giving away somewhere.

Where more than one string is used, we have the following effects:

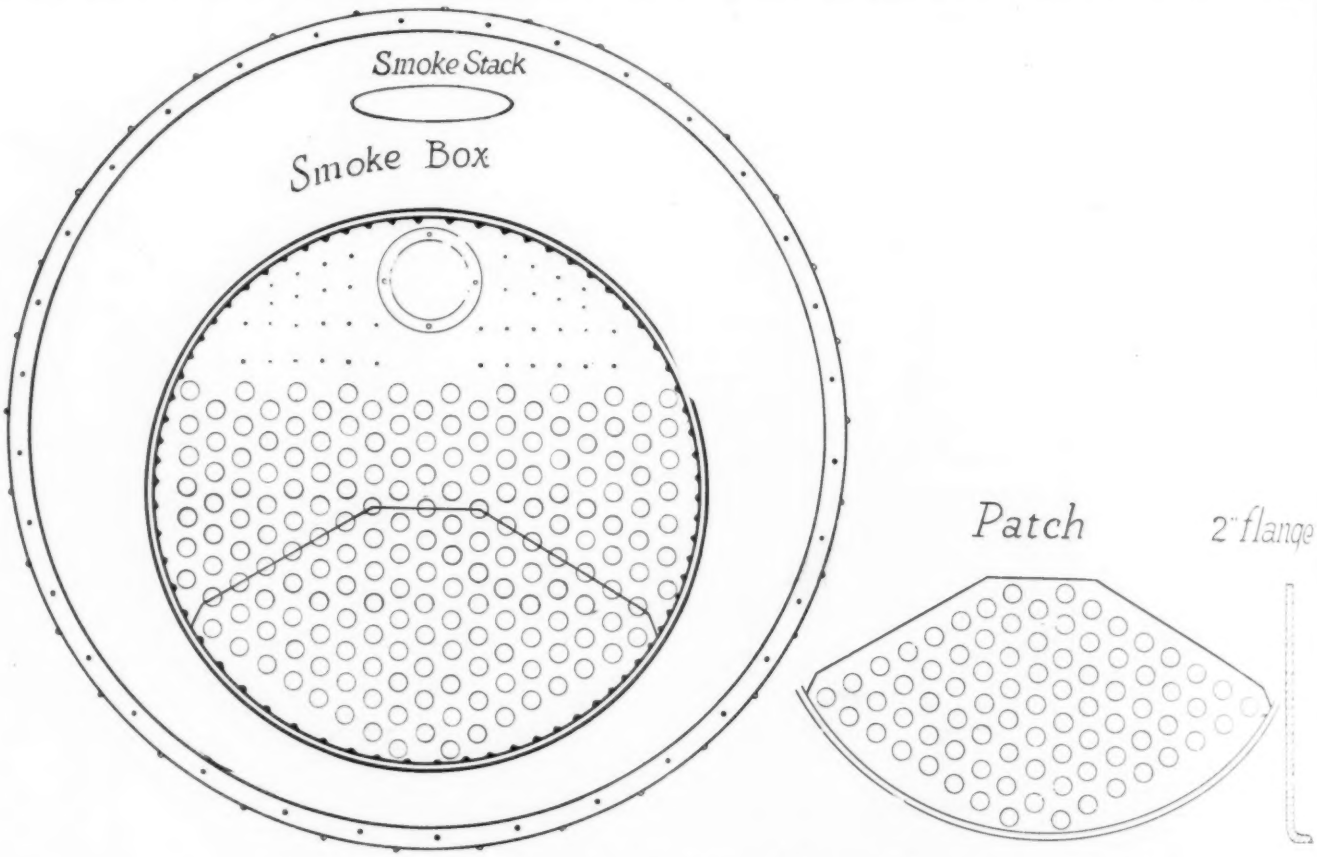
The first string is cooled with extreme rapidity and therefore contains relatively large cooling strains, and possesses a coarser grain and a greater degree of hardness than is desirable. The next string deposited on top of the first one heats up the first one and covers it with a blanket of molten metal which, according to Mr. Armstrong, should irretrievably spoil a good share of the first string, but in spite of this statement, and in accordance with his own experience as well as ours, the actual effect of the matter is that the blanket of hot metal causes the first string to cool much more slowly than the first time from a temperature considerably below the first temperature, and in this way anneals the first string and improves its grain or molecular structure.

When properly handled, a very high grade of metal can be produced by depositing a number of strings one after the other, and then in the finishing process remove the outside strings.

With regard to the reference to Mr. Bryan's remarks on the voltage, we might say that the voltage is nothing more or less than a measure of the length of the arc. In fact, it is about the only way we have of measuring the length of the arc, and, according to our own experience, Mr. Bryan is quite correct in his statement that the voltage or length of arc is of the utmost importance, because it determines the amount of heat energy that is applied to the metal in its passage from the pencil to the work, and it is right here that burning takes place. The shorter the arc, the better will be the grain and density of the metal.

We are operating under commercial conditions, with arcs from 18 to 22 volts, and obtain steam-tight joints without caulking or in any way treating the weld after it is completed. Everyone of these joints is tested and never has one been found with a leak in it.

O. A. Kenyon,
Electrical Engineer, Arc Welding Machine Co., Inc., 220 W. 42nd St, New York, N. Y.



Method of Patching Flue Sheets, Described in Lower Right-hand Column of This Page.

Editor:

Please find enclosed a very crude sketch of one of my methods of patching flue sheets of locomotive and other types of boilers. In this sketch I am endeavoring to represent front view of locomotive boiler, smoke box and front flue sheet. After removing rivets from flange of section below marks through flue holes, I cut out section at line through flue holes

with cutting torch. I then flange and drill new section or patch. I drill all rivet and flue holes except the flue holes coming directly in the welding line which would be half holes. I leave these half holes blank until I have finished the welding. After welding I cut the half holes out in the new section to match half holes in old sheet. Cut the half holes with cutting torch and true up with reamer. Bolt patch down fast at flange and clamp tightly in place at top. Now weld flange on both ends first. Weld the bridges of the old sheet to the new section or patch from sides to center. Weld the bridges first one side and then the other side until reaching center. All edges should be bevelled to about 45 degrees for welding. This job only required about 2½ hours' use of the torches, both cutting and welding, and is a first-class job when properly welded.

If this is of any use to you I will try to furnish you with some more from time to time.

W. T. FUNSTON.

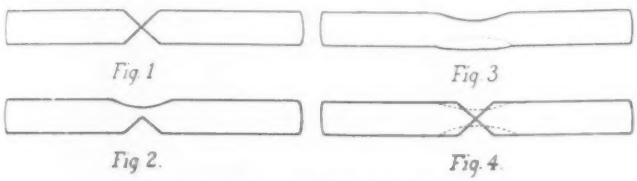
324 E. Butler Ave., Memphis, Tenn.

Editor:

I recently sold some welding equipment to a man who was at one time a blacksmith and who had had considerable experience in welding steel bars at a blacksmith's forge. It had always been his practice to test each weld that he made, and much to my consternation he applied his test to some welds which I had made with an oxy-acetylene torch.

The test itself was very simple, but it was also very effective, and it occurred to me that some others might like to try out their skill in this particular line of welding.

His method was to heat up the bar at the point of the weld to a bright red heat, place one end of the bar in a vice, about



Method of Testing Welds.

1 inch from the weld, put a good big pipe wrench on the other end and give the bar one complete turn. Now, this may not sound like a very severe test, but I assure you that if there is any defect in the weld it will show up under this treatment.

If a break or crack of any kind appears, the weld is not up to standard and another good turn will twist the piece in two. Then the ends can be examined and the reason for the failure determined. If part of the original champher appears, the weld was not started right; if the metal looks coarse or sandy, the metal was burned.

Of course, this test need not be applied in every instance, but a test piece might open the eyes of some of us.

For the benefit of those who have not had much experience in this kind of work, I will give in a general way what I believe to be the best way to weld a steel bar.

First grind down the bar from two sides, making a good wide angle so that the welding jet or small white cone can penetrate down to the very bottom of the groove. Figure 1 shows the piece champhered and ready to be welded. Now apply the torch, and without adding any new metal, run down the two sides of the original pieces until the piece appears, as shown in Fig. 2. The next step is to add your new metal until it is a little more than flush with the rest of the bar. Then turn the bar over and proceed in the same way with the other side, being sure not to add any new metal until both sides of the groove are run together, as shown in Fig. 3.

After the weld is made, round it out with a hammer, being careful not to hammer it too hard or too long. Allow the bar to cool for 15 or 20 minutes, then reheat to a bright red and apply the test. If the weld holds, you have done something to be proud of; if not, just remember that practice makes perfect, and try again.

Fig. 4 shows how by running down the edges of the original piece you get a strong, sound weld in the center, and by applying the new metal drop by drop you get a weld that is very nearly perfect.

ROBT. B. DYAR.

Rochester, N. Y.

Editor:

I notice in your June issue an inquiry by Mr. W. W. Smith in regard to the best material to use for welding automobile springs. In the June issue of Machinery there is a little further explanation of the strength of steel welds which may be of interest in this connection.

It is evident that the welding of springs with Norway iron wire, or other low carbon material, will not give a material in the weld that contains as much carbon as the spring, and, in fact, such welds contain practically no carbon, and therefore they cannot be tempered in the weld. It is evident that if more carbon could be got into the weld the results would be a somewhat stiffer job, and the rapidity of cooling in the air, although it is not as rapid as in the tempering process, would give some degree of stiffness to the added material. I find that the use of old bed springs, which contain about probably between .8 and .9 per cent carbon, gives quite satisfactory results in many cases. Of course, during the melting of this material a good deal of the carbon is burnt out of it, but enough is left to increase the stiffness considerably over that of welds made with low carbon steel wire. In all cases care should be taken to grind the weld smooth and level with the original surface. Such a weld should be made rapidly with a comparatively large tip, and should not be gone over, enough metal being added to make a sound job after grinding, and the heat kept on the metal as short a time as possible. One reason for poor results in steel welding is that the welder does not know the composition of the steel, and he therefore cannot obtain the same results in all cases. The instance you quote of the difficulty experienced by one man with a welded spring is a very good one and simply proves that there is nothing certain about a welded spring, and shows that any job of this kind is not a certain one.

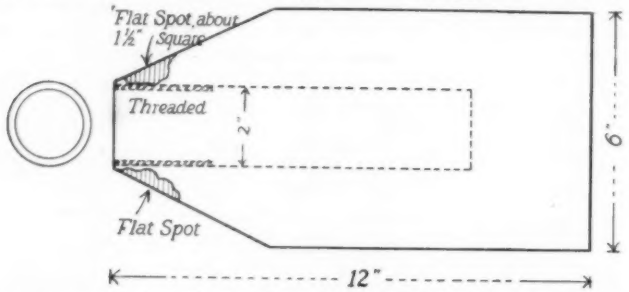
In regard to question No. 2 in "Questions and Answers" and your reply, it looks as if your correspondent did not heat the malleable iron quite hot enough. I should judge from what he says that the bronze pulls away cleanly from the weld, and I am inclined to believe that this occurs only on one side, and that the other side is probably sound. I would suggest that the inquirer take several pieces of malleable iron and weld them as is his custom, then put them in the vise and break them, endeavoring to break the bronze from both sides of the V. If it breaks from both sides, the malleable iron is undoubtedly not heated quite enough. By experimenting this way, he will find out the proper temperature, of course gradually increasing the heat until it is located accurately. If the bronze sticks to one side and not to the other, the same old trouble, which has existed as long as the process has, is undoubtedly the cause. A right handed welder will always heat the left side of the V hotter than the right, and a left handed welder will do the opposite. This is caused by the way the torch hangs in the hand, and in this case the only thing necessary to do will be to see that both sides are brought to the same and proper temperature.

Rochester, N. Y.

S. W. MILLER, M. E.
Rochester Welding Works.

Cast Steel Shells.

Approximately 6 inches in diameter and 12 inches long, about a 4-inch taper with a 2-inch hole drilled in the center about 9 inches deep. This hole is threaded or tapped about 2½ inches long. After being turned up several flat places were discovered at the tapered end, which caused the inspector to turn them down. There was only one chance to save them; "welding." So the company decided to try two first. The wall between the threads and the flat spots on the outer surface was approximately ⅜-inch thick. I



was warned that if the threads scaled the shell would not pass as the threads would be imperfect. By bringing the outer surface to a melting point I knew the threads would scale, so I filled the shell with water; standing it upright and using a large sized tip. As I would bring the metal to the melting point the water would boil and jump out of the shell so I had a helper keep pouring water in during the welding operation. This kept a scale from forming and when finished they turned out perfect.

B. J. Lheid.

Questions

Editor: Will you please give us some information as to the danger in welding sulphuric acid steel tanks, used to store acid 92½ strong or 62 gravity?

Waterman Welding & Machine Works.

Answer: One large shop we know of in the West follows the plan of filling up such tanks with hot water, afterwards running live steam into them. They state they would not undertake the work without doing so.—Editor.

Editor: Can you tell me where I can get a market for copper, brass and aluminum junk?

SPRINGVIEW GARAGE,
Springview, Neb.

Answer: Unless you have from one hundred to one hundred and fifty pounds of scrap metal, of each kind, it would not pay you to ship any distance. There are probably plenty of people in the nearest large city to your town who will buy your scrap. One large buyer in Chicago quoted on June 23rd, 42 cents per pound for scrap aluminum, 12 cents for brass and 18 cents for copper. We are mailing a list of dealers in nearby cities.—Editor.

BIG SALE OF APPARATUS.

The indications are that 1916 will be the banner year for manufacturers of welding equipment. Up to July manufacturers' report orders as far exceeding last year's business for the same period. In some instances last year's business will be more than doubled.

DISABLED FRENCH SOLDIERS TAUGHT WELDING

Referring to the third course of instruction Mr. Pierre Rosenberg in the Bulletin de Acetylene says this course was conducted on the premises of the Union de la Soudere Autogene. The instructions were under the direction of M. Roulleau, the class consisting of fifteen disabled soldiers. For the first three days short lectures and demonstrations occupied the mornings, while the afternoons were devoted to practical work. The last three days the pupils were taken to workshops, where practical demonstrations in welding bombs were given.

We are happy to state here how well timed was this action of the Union de la Soudere Autogène, for M. Albert Thomas, Under-Secretary of State for Munitions, has recently notified that he would be gratified, for many reasons, if the establishments working for the War Department would institute short terms of apprenticeship for disabled soldiers where they could start on certain crafts, thus rendering a double service to the State by permitting the war-broken men to earn an honorable livelihood and releasing the sound men for the defense of the country.

The first course of instruction for the disabled was held in July, 1915, and if the Union has done but little, it is because it has strictly limited the number of workers thus trained to the demands of the workshops requiring welders.

Certain welding workshops would like to have had sent to them fully competent welders able to do any sort of work; they were not willing to complete the education of the novices.

The Union could not turn out perfect welders in so short a time, but if the welding workshops had been desirous of co-operating in this interesting work, and had employed to some extent the brave men whom the Union had roughhewn in a few days, they would have had good workmen and also would have been rendering a double service to national defense.

The Union is ready to do the needful, if it is assisted and if it is certain that the workmen started will be assured employment. It is necessary not to lose sight of the fact that after the war the skilled workmen will be difficult to find, at any rate for some time. It is then with a thought of the future that a new start has been given to these workmen who, because of their wounds, can no longer carry on their former trades.—Acetylene Lighting & Welding Journal.

ENGLISH MANUFACTURERS TAKE JOB WORK.

The oxy-acetylene welding and cutting process is coming into wider use every day in what might be called manufacturing welding and cutting. A good acetylene generating outfit is rather expensive, so a fair volume of work for it must ordinarily be in sight to warrant purchases, and this is generally the case in most engineering shops.

Where regular manufacturing work is done, the capacity of the plant is often greater than required, and most firms find it an advantage to develop a jobbing field. In a fair-sized establishment it would almost pay to employ an expert to do nothing but find work for the blowpipe, not simply to keep the blowpipe busy, but to save money on the work undertaken, because in those cases where the blowpipe can be used it gives surprising results in reducing costs. —Acetylene L. & W. Journal (England).

NEW RECORDS AT SOUTH BETHLEHEM

Figures given out by the Bethlehem Steel Company show that a number of records at the South Bethlehem plant were broken in May. The exceptional performances are indicated in the following: Blast furnaces, total production, 80,171 tons; best previous production, October, 1915, 79,169 tons. Furnace "A" for month, 17,212 tons; best previous record, December, 1914, 16,779 tons. Open-hearth furnace No. 3, 14,620 tons for May; best previous record, March, 1916, 12,693 tons. Merchant mills: 22-in., mill, No. 2, 8,181 tons; best previous record, March, 1916, 7,670 tons. —*Iron Age.*

Welding Broken Steel Auto Parts

Automobile Repairs Are Increasing in Volume—Shops Doing Job Work Will Find This Subject Interesting

By Harry B. Hoover

Steel is one of the hardest metals for the beginner to learn to weld. The trouble with the new beginner almost always is a tendency to fill in from the filler rod before the metal is really in a molten condition. Sometimes a fairly good looking weld will be produced, but it will not have any strength, as the hot metal flowing over the cold metal did not unite and make a solid unit, but simply adhered to it and will peel off or break away as soon as the strain comes on the weld. Others have trouble by getting holes in their metal and being unable to fill these up without melting off of the filler rod into them and filling them up in this manner. This leaves a cold-shot or a defect in the weld. The cause of the above trouble is that the piece is not hot enough.

In the first place, if the metal is not over ⅛ inch in thickness, it can be welded without a filler rod, unless it is necessary to reinforce it and make it heavier than it was originally. Thicker pieces than ⅛ inch should be beveled or chamfered to about 45 degrees, as in welding other metals. The piece should then be preheated either by welding torch or other means to a cherry red at least twice the thickness of the metal back from each side of the fracture before starting to weld. If this is done the metal will start to flow almost the instant that the welding flame is brought in contact with the surface of the metal in the weld. Never use a filler rod until the bottom and sides have been brought to a molten condition and the sides flowed down into the bottom, filling it somewhat.

The weld should always look smooth and regular and not become full of holes and irregular. If the latter occurs, the tip is not large enough to keep the metal in a molten condition. In some instances a foam may be produced on top of the weld. In this case the metal is being burned. This could be caused by using too large a tip or by not having an absolute neutral flame. A neutral flame should be maintained at all times.

When the bottom has been filled in from the sides of the weld and is smooth, it is then time to add in from the filler rod. The rod should be or almost in contact with the weld. In this manner the flame will keep the weld in a molten condition, melting the filler rod at the same time and the two will flow together much better than if the flame was lifted to the filler rod, allowing the weld to cool. After a small amount of metal has been added onto the weld, the rod should be lifted and the metal thus added worked in with the flame until the surface is entirely free from any irregularities or light colored streaks.

Keep the bottom and sides in a molten condition, not too liquid, but more plastic. Do not hold the flame too long in one place, but keep it moving in a circular motion with an uplifting movement at each rotation, the object being to drive the molten metal to the center of the weld. This process should be continued throughout the entire operation.

There is a vast amount of difference in the preparation and welding of broken parts. It depends on where it is broken. A crank shaft broken, as shown in Fig. 1 at A, is much more difficult to weld than one broken as shown in Fig. 1 at B. The fracture at A is in a corner, or in other words, it is at the shoulder where a small piece joins onto a larger one. This is where the difficulty comes in in welding a small piece onto a larger one, especially up against the flat surface, as in this case.

The writer knows that any amount of welders call this an impractical weld, and would not weld it at all. But the writer also knows from actual experience that this is just as practical a weld as any other weld on a crank shaft. However, it takes more time to prepare and make a weld of this kind. There are two ways of preparing this weld. One is to cut away the throw or large part of the shaft as shown in Fig. 2 at A, leaving a thin strip to align the shaft properly. The bearing or pin would be chamfered down to compare with the strip on the arm. This strip should not be more than 3-16 of an inch in thickness.

To align the shaft it should be placed on a face plate with V blocks under the main bearings and at least 3 V blocks under the crank bearings. If the sides or edges of the face plate have been machined, the crank can be aligned up side-

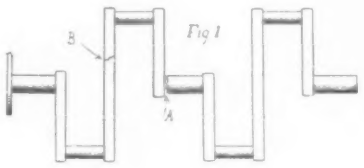


Fig 1

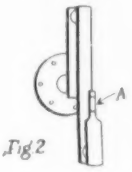


Fig 2

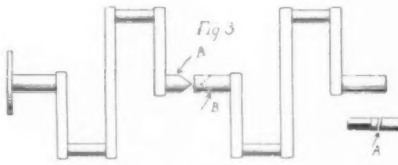


Fig 3

Fig 4

ways by bringing the V blocks in alignment with the edge of the plate. Clamp the shaft down in this manner and make the weld on one side. If the shaft was preheated to a cherry red back 3 or 4 inches on each side of the fracture before starting to weld, the weld could be made much easier and quicker, as explained above. The shaft should be filled in and made a little larger at the weld, so as to allow for machining. After the weld has been finished on one side, turn it over and finish the other side, being sure to clamp it down. The aligning with the edge of the plate will not be necessary this time. It will be necessary in making the weld on this side to melt down through the fracture until the solid metal is reached, then fill it in as on the other side and make it large enough to allow for machining.

The other way to make this weld would be to build up on the broken surface of the throw or arm until a projection of 1 inch or more long is made, as shown in Fig. 3 at A. Then cut off as much of the pin or bearing as has been added to the other part, as shown at B, chamfer the edges and align the same as mentioned above. The shaft should also be preheated as before explained. In finishing the weld be sure to build it high enough to allow for machining.

To make a weld as shown at B in Fig. 1 is very simple. It has only to be chamfered as in ordinary welds, aligned properly and welded. The weld in this case should only be built up even with the surface of the shaft, as no machining should be necessary in this instance. However, it will have to be put in a lathe and trued up.

It is almost impossible to hold a crank shaft in perfect alignment while welding, but the nearer it is to straight the better, as it requires less machining. If a crank shaft is not straight or does not run perfectly true, it is absolutely no

good. The writer believes that a great number of crank shafts that have been broken after being welded is due to poor machining, rather than poor welding. The writer's experience in welding crank shafts has been very successful, having welded one shaft off of a 300 horse power gas engine. This shaft was 9 inches in diameter and weighing 3 tons. This shaft was welded seven years ago and is in service today.

A rear axle or drive shaft with the square broken off as in Fig. 4 at A, is very easy to weld. The old square is thrown away and a new piece of metal about 1-16 of an inch larger in diameter is welded on in place of the old piece. This allows plenty of stock for machining down and making true. If the old square was used it would be almost impossible to get it absolutely true. If the break should be at the flange, as in B, the weld would be prepared and welded in the same manner as the weld at A in Fig. 1. By just building up on the flat surface of flange a lug a little larger in diameter than the original shaft and about 1½ inches long, cut 1½ inches off of broken end of shaft, bevel, align and weld, and remember to always make the weld larger to allow for machining.

A weld made at a flange or shoulder in this manner is very satisfactory and is the only practical way to accomplish it.

In welding teeth in gear wheels, transmissions, differentials, etc., if there is more than one tooth out of a gear in one place, it would be advisable to fill the space in solid and have it machined out. But if there is only one tooth out, it would be easier to build up the tooth as near as possible to actual size and there will be less machining necessary. The old teeth are never used, but are built in new from the filler rod. The rod used for this should be nickel steel. After the gear is machined it will then have to be case hardened as before.

Straightening and Welding of Auto Frames

If the frame is broken just back of the gooseneck and at the point where the sub-frame crosses, it will not be necessary to reinforce it any more than to weld the side frame and sub-frame together. To accomplish this weld, jack up the front end of the car on the broken side by placing a jack under the frame just back of the spring. The weight of the wheel and axle will have a tendency to pull the frame back into alignment, providing it is not broken entirely off. If such is the case, it will be necessary to loosen the spring and block the frame up in perfect alignment. If it has been bent or twisted, the weld should be made first and straightened afterwards.

After the frame has been prepared for welding, the underneath or bottom side should be welded first. In some instances the top side of the bottom flange can be reached. In this case the weld could be made entirely through from this side and then re-inforced from underneath, but if it cannot be reached from the top side, it will have to be welded through from the underneath and re-inforced considerably with new metal. The weld should be started from the inside and worked out. In making the weld up the side of the frame it should be started at the bottom and worked up. In this way the metal melted out will flow down into the weld and a filler rod will not be necessary until the top of the frame has been reached, as the metal can be worked down and used instead of a filler rod.

It is sometimes necessary to re-inforce the frame if it is broken in a weak place, by either welding a piece of angle iron over the weld on the inside of the frame, or if this is impossible, place a flat piece of band iron (about the same width of the underneath side of the frame ⅛ inch thick by 3 inches long), on the underneath part of the frame and weld it fast. This will strengthen it considerably.

In straightening a front axle, it can be accomplished in most cases without removing the axle. If it is bent back and up in the middle it would be necessary to block the two front wheels and nail a block to the floor about 3 [illegible] back of the middle of the bend. Place a jack on the [illegible] side and block in between it and the block on the floor. [illegible] screw jack is much better than a ratchet jack). The jack [illegible]ld be forced out against the axle, then the welding frame [illegible] large size tip being used), is thrown on the axle where it [illegible] anted to bend and heat up to a bright red. Care must be [illegible]ed in heating the axle not to get the flame too close [illegible] and cause it to melt. As soon as it gets hot enough, [illegible] the jack out until the axle is straight sideways. It will [illegible]ill be bent up. To straighten this it will be necessary to [illegible]ave a two-by-four or something similar about 3 or 4 [illegible] long. Take a piece of Norway welding rod ¼ inch size [illegible] twist it around the axle, leave it loose enough to slide, [illegible] place the two-by-four under the axle lengthwise and put [illegible] other end of the rod around this and fasten. Place a jack on each end of the board almost touching the axle, heat the same as before. When it is hot slip the wire attached to the board to the center of the heated spot and screw up on the jacks until the axle is straight. This will have to be done quickly, but it is very easy to do after you once understand how. After the axle is straight, the jacks should be left until the axle is cold. If it is bent up at the end, jack up the car at this side in front by placing a jack under the axle just back of the bend, then place a bar through the wheel under the hub, place one end under the axle and put a block between the rim of the wheel and the bar. This gives a leverage on the axle. Heat up the point to be bent and bend down into position, leaving it jacked up until cool. When the axle is bent down place a jack under the hub and raise the wheel up, put a second jack under the axle just back of the bend, heat up the point to be bent and let the inside jack down until the axle is straight. Allow to cool before removing jacks. Axles can be straightened in this manner without the trouble of taking them out, and it can be done much quicker.

A MOTOR-DRIVEN SEAM-WELDING MACHINE

A new type of motor-driven seam-welding machine has recently been put on the market by the Toledo Electric Welder Company, Cincinnati, O. These machines are especially adapted for welding the side seams of coffee pots, pails, phonograph horns and other articles made from clean, nickled sheet steel of light gauges. It is stated that the edges of the stock overlap only from 1-32 to ⅛ in., and that the pressure of the rolls forces the stock together so that it is only from 0.002 to 0.003 in. thicker at the joint than it is outside the welded area, so that when the articles are enameled or japanned it is almost impossible to detect the place where the weld was made.

The machine is also used in the manufacture of oil stove cylinders that are 3¼x4½ in. of No. 24 lead-coated stock, where the weld, of course, must be absolutely tight and with a smooth finish. It is claimed that 5,000 of the cylinders can be welded on the machine in 9 hours. The rolls pass from the cylinder at the rate of 18 ft. per minute, and only a fraction of a second is required to weld a 4½-in. seam. Two men operate the machine and two jigs are used. One operator places the stock in the jig and passes it to the man doing the welding, and while this operation is being done the second jig is filled as quickly as the first piece can be welded. The jig holding the cylinders is placed over the lower stationary horn of the welder that serves as one electrode. A slight pressure on the foot treadle shown trips a clutch that sets a worm drive in motion and thus carries the upper copper roll over the overlapping edges of the stock to be welded. The roll passes from the cylinder in 1½ seconds and the current in automatically turned on at the instant that the copper roll touches the cylinder, and it is turned off immediately when the roll reaches the outer edge of the cylinder. At the same time the worm drive is reversed and the roll is returned

to its original position ready for the next weld. The roll is water-cooled to prevent overheating.

An alternating current of either 25 or 60 cycles can only be used at either 220 or 440 volts. A special transformer located inside the machine reduces the current to about 3 to 5 volts, so that there is no danger of the operator receiving a shock. Based on a current cost of 1 cent per kilowatt hour, it is stated that the expense would be only 10 cents per 1,000 ft. of welded surface.

To take care of varying thicknesses of stock, a regulator is furnished to give different degrees of heat at the weld and the pressure of the rolls can be varied to suit the different stock used. The speed of work depends practically on the size and shape of the pieces handled and the rapidity with which the operator can pass them over the welding horn.

THE LARGEST WELD EVER MADE

Thermit Repair on Cast Iron Shears for 48 in. Blooming Mill at Pittsburgh Steel Company, Monessen, Pa.

By H. D. Kelley.*

Through the courtesy of Wallace H. Rowe, president of the Pittsburgh Steel Company we are enabled to publish a

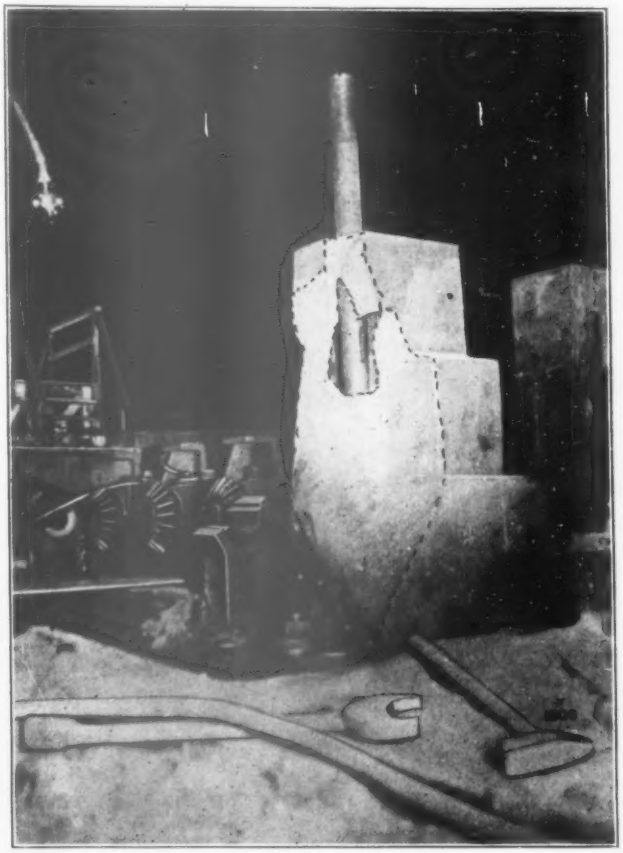
Thermit Weld—Brokn Part in Place, Showing Braces to Hold It in Place. Dotted Lines Show Wax. Front Reinforcement Cannot Be Seen.

description of the recent repair of their cast-iron shear bed, and which resulted in making the largest Thermit weld ever before completed.

A piece of steel became wedged between the stationary blade and movable blade of the shear and resulted in breaking off entirely the stop holding the stationary blade. The broken piece was of a regular shape approximately 37 in. x 5 ft. x 6 in. and weighed about 3,000 pounds.

I was called upon to inspect the shears March 1, 1916, and ordered material by telegraph that day, to be shipped from our Jersey City plant by express. In the meantime the shears were patched temporarily, so as to enable them to run the mill until the arrival of the material. The mold box was made and sand secured, and as soon as material arrived on the ground and everything was ready for the weld I returned to Monessen.

At 12:30 p. m., Saturday, March 11th, the mill was shut



Thermit Weld—Dotted Lines Show Line of Break, After Broken Part Was Removed.

down and the work of stripping the shears commenced. The fractured parts were thoroughly cleaned and the broken piece placed in position ready for welding. This part of the work was completed by Sunday morning, at which time the wax was applied and the mold box placed in position. This was a square sheet-iron box 110 in. x 110 in. x 119 in. deep. with no bottom or top. The box was placed in position by means of a traveling crane, and oxy-acteylene was then used to cut the bottom of the box, so as to fit properly over the shear frame. When the box was firmly anchored in position the big job of ramming the molding material commenced. This required until Monday afternoon.

Five No. 10 crucibles were then supported over the mold box and filled with Cast Iron Thermit, everything being ready at about 9 o'clock Monday night, when the preheating was started. Three burners from the Goldschmidt Thermit Company preheaters were used and kept going until 5 o'clock Tuesday afternoon, when the casting was hot enough to permit of pouring the weld. The preheating holes were then plugged, the Thermit ignited, and the resulting metal poured into the mold. This was completed just 84 hours from the time the work was started.

The weld was poured with entire success, and was allowed to stand until noon of the next day (Wednesday), at which time the front of the mold box was taken off, thus exposing

*Pittsburgh Manager, Goldschmidt Thermit Co.

the front of the weld only. The object of this was to allow the heat to radiate from the main body of the casting through the weld. The rest of the mold was left on until 6 o'clock that evening, when it was entirely taken off. The metal left in the risers was cut off, and as there was no other machine work to do the reassembling of the shear was started and finished by 7 o'clock the next morning, March 16th. One hour later, at 8 a. m., the mill was started up, and has been doing business every minute of the time since.

It will be seen, therefore, that the mill was only shut down from March 11 at 12:30 p. m. to March 16th at 8 a. m., which I think is a record for such a large repair.

Much credit for the success of the operation is due to R. E. McIlvried, master mechanic of the Pittsburgh Steel Company, who was on the job every minute of the time from start to finish, something over 100 hours without rest or sleep. I feel safe in saying that no one connected with the repair worked harder than Mr. McIlvried.

The accompanying illustrations show the various steps of the operation, but, unfortunately, they had to be taken by flashlight under difficulties, and are not as good as I would wish.

Straight Lines Show Corner of Casting. Dotted Lines Show How it Was Reinforced. This Is Finished Weld—Mould Just Taken Off.

Completed Job. Dotted Lines Show Reinforcement. Cost $50,000 Per Day to Shut This Mill Down. New Casting Would Have Taken Six Weeks. Repairs Completed Between March 11th and 16th.

M. C. B. DISCUSSES WELDING

At the recent meeting of the Master Car Builders' Association, at Atlantic City, the subject of welding was discussed. In commenting on the Committee report the Railway Age Gazette says: "This is a new subject which has received the attention of a committee for the first time this year. The welding of cracked castings has been made possible by the introduction of the oxy-acetylene and electric welding processes and the practice has been extensively applied to the reclamation of bolster and side frame castings, which it would otherwise be necessary to scrap. The limits which have been set in the recommendations of the committee to a large extent retain the possibilities for saving in the cost of renewals offered by the autogenous welding processes. Considering the lack of substantiating data in the report of the committee, however, the minority report condemning the practice as unsafe deserves the careful attention of all M. C. B. members.

W. O. Thompson, superintendent rolling stock, New York Central, is chairman. He became an apprentice on the Fort Wayne, Jackson & Saginaw, now a part of the New York Central, in 1877. He was subsequently a fireman, engineman, traveling engineer, general foreman and division superintendent motive power on the New York Central System. In July, 1907, he became master car builder at Buffalo. The other members of the committee are G. W. Rink, mechanical engineer, Central Railroad of New Jersey; J. T. Wallis, general superintendent motive power, Pennsylvania Railroad; J. J. Hennessey, master car builder, Chicago, Milwaukee & St. Paul, and M. A. McGill, assistant superintendent motive power, Lehigh Valley.

The Committee on the Welding of Cast-Steel Truck Side Frames and Bolsters desires to submit the following recommendations, one member of the committee dissenting.

Truck Side Frames.—Cast-steel truck side frames must not be welded if cracks extend more than 1 in. from edge of any rib or flange.

Bolsters.—Cast-steel truck bolsters must not be welded if cracks extend more than 1½ in. from edge of rib or flange, unless bolster is reinforced at the place of failure by the addition of plates, either welded or riveted, to bolster.

The report was signed by: W. O. Thompson, A. M. McGill, J. J. Hennessey, and Geo. W. Rink.

Minority Report

I can not concur in the report of the majority of the com-

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SAN FRANCISCO, CALIF.
MOBERLY, MO.
W. BERKELEY, CALIF.

mittee permitting welding of cast-steel truck side frames and bolsters, as I consider the practice of welding cracks in these members, by either acetylene, electric or any other present known method, unsafe, for the reason that the fractures indicate weakness in design, and the welding will not add to the strength, but introduces a condition of further weakness by improper workmanship.

It is a well-known fact that a large number of cast-steel truck side frames and bolsters, especially the former, are failing as a result of weakness in design. Where the proper sections are used, and the design proven, these cracks do not appear.

I cannot, therefore, subscribe to a practice of continuing in service such vital parts of car construction which, as evidenced by fracturing, are inherently weak, or to a method of repairs which in no way strengthens the part, but, on the contrary, introduces another chance for failure, and consequently is unsafe.

The report was signed by:—J. T. Wallis.

Discussion

W. O. Thompson, (Chairman): In the committee's rather extended investigation of welding of parts of the car mentioned in the report, they have found that the art of welding not only truck frames and bolsters, but other parts of cars, and also the building up of worn parts of castings is being developed very rapidly. We believe that the recommendation made by President MacBain in his opening address in regard to this matter is a very pertinent one, namely, that a committee be appointed to investigate this rather important matter in its entirety.

F. F. Gaines, (C. of G.): I have had some tests made on oxy-acetylene welds, where the weld was shown to be stronger than the original article itself, and I think in view of the state of the art and the decreased cost to the railroad companies by the use of this process in repairing parts of cars, that the majority report of the committee should be accepted, and I therefore move that it be submitted to recommended practice.

E. S. Bilty, (C. M. & St. P.): I have seen cast side frames welded which were stronger in the weld, another portion of the frame failing. A committee should be appointed to look further into this practice and ascertain as to how the welding may be properly done. Where failures do occur in a weld, I believe it is entirely on account of improper welding. It is my opinion, however, that we should continue this practice in view of the economies presented.

C. D. Young, (Penna. Lines): The President in his report and the Chairman of the Committee feel that this is a subject which should be thoroughly investigated and a proper report made. I would like to see that prevail in preference to the motion which has been made by Mr. Gaines. Unquestionably, what Mr. Gaines has said is entirely correct, the welded parts can be made stronger, but in making them stronger it is necessary to increase the section at the point where the weld takes place. Certainly, it cannot be made stronger than the original section if made in equal sections.

There is another element which comes in in making the joint stronger at that point; there is apt to be a localized strain at a point immediately back of it, both due to the changing structure of the steel and the increase in section. Our experience has been that in welding, workmanship plays an important part in the result you will get on the weld. Ordinarily, with skilled workmanship the ductility as expressed by the elongation will be materially reduced from what you will find normally in materials of the same character, although the strength might be within 80 or 90 per cent of the original strength. That is brought about largely by the fact that in making the weld the material cools very rapidly and hardens quickly, and unless it is reannealed, as the casting was originally produced, low elongation is bound to exist. It seems to me in view of the far-reaching character of such a recommendation as to submit this to letter ballot, if it were passed, would be a mistake without the subject being gone into very thoroughly by the Association.

J. J. Hennessey, (C. M. & St. P.): I agree with the recommendation made by the Chairman of the Committee. I think the subject should be thoroughly investigated. What has been said about workmanship is true, I do not know of any part of a car that cannot be spoiled by the workmanship. I do not believe that the railways of the country today are in a financial position to scrap certain material, which with a very small amount of labor and added material can be made as good as new.

It is true if you take one of the truck sides and put a torch on it, heating up a little space of about 2 in. at one point, that that would not be good workmanship. The truck side or the bolster—perhaps the truck side is the most important—should be heated at least for a distance of from 8 in. to 12 in. at the point where the weld is to be made, and in addition to that the welded portion should be cooled by covering it with ashes, as is commonly done in blacksmith shops or in the case of any welding or bonding where good work is done.

Samuel Lynn (P. & L. E.): I will emphasize what Mr. Hennessey has just said. We have for three years probably been having truck sides welded. We have not attempted to weld one of them in our own shop. The manufacturer, under contract, has welded the truck sides that have failed, under the guarantee, and also welded some truck sides that have outlived the guarantee, and the manufacturers, in addition to the welding processes, have put the truck frames into annealing furnaces. These frames, when they come back to us, are put under the cars, and we have not found one which failed after it has been welded, and in view of our experience I think that the committee should go into the matter very carefully and see what can be accomplished by the welding process.

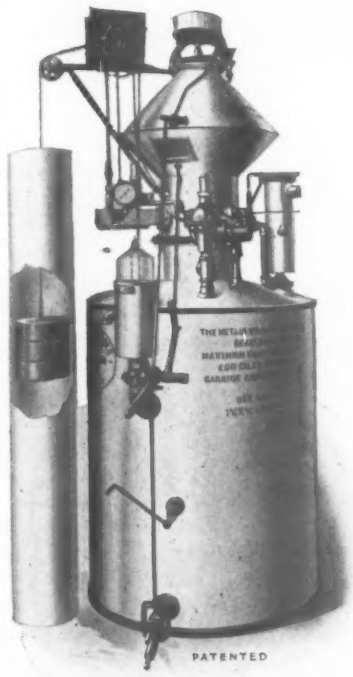
Mr. Young: I will make an amendment to Mr. Gaines' motion—that this subject be referred to the Executive Committee, with the recommendation that the views of the Chairman prevail, and that a special committee be appointed to investigate the subject and determine the possibilities and limitations of this practice with reference to truck sides and bolsters. That if welding is to be permitted that certain specific instructions shall be framed, as to how the work shall be performed in order to produce the result desired to bring the structure up to a proper condition for service.

C. F. Giles, (L. & N.): In view of the fact that some of our connections have instructed their inspectors to reject cars with truck sides and bolsters which have been welded, I think we should have some understanding as to what the practice should be pending a settlement of this question.

Mr. Gaines: I am perfectly willing to accept Mr. Young's amendment to my motion, but I think we should be allowed to continue our present practice until the committee has described some proper method, and the association recommends its adoption. In the meanwhile, I think the committee's original report should stand.

D. F. Crawford (Penn. Lines). What difference would it make in the acceptance of cars whether the majority committee report stood or did not stand? In the code of Interchange Rules the receiving line has the right to determine what is safe or unsafe for transportation over its lines, and I do not think any action can be taken by the convention that will make obligatory the receiving of cars by a line that does not wish to receive them, with the welded side frames or any other defect. Therefore, it seems to me that when there is a minority report on such a subject and so much question as to safety involved, that we can well wait until another convention for some specific directions that can be embodied in the Code of Interchange Rules.

Mr. Gaines' motion, with Mr. Young's amendment, was put to a vote and carried.



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WELDING OF JOINTS IN GAS MAIN CONSTRUCTION.

Paper Read by F. L. Hadley, Supt. of Lines, Peoples Natural Gas Co., Pittsburgh, Pa., Before the Natural Gas Association

The subject which is treated in this paper is one which has become of great interest to all gas men and especially so to those interested in the construction and maintenance of lines and the transportation of natural gas from the field to the different markets.

From what we now know of the oxy-acetylene method of welding pipes together it appears as if the ideal method of constructing natural gas mains has been discovered and that it will mean as great a boon to the natural gas industry of the future as the discovery of the coupling was to the past, and while it is true that this method may not lead to the building of as many long lines to reach distant markets as did the development of couplings used in connection with plain end pipe, yet it will mean that the leakage as being one of the principal factors in the transportation of gas will be practically eliminated, effecting a saving of many thousand dollars annually to all of the large gas companies, besides giving us cheaper lines to build and operate.

This method of laying lines has been tried out very extensively by artificial gas companies during the past few years and in all cases of which we have knowledge it has been found to be very successful both in economy and in securing good tight lines. Some of the eastern companies are now welding all their extensions, including the mains and service lines down to ¾-in. pipe. At the time which this paper is written the writer is engaged in installing such a plant which will consist of 14 miles of 8-in., 9 miles of 6-in. and approximately 10 miles of smaller pipe, together with several hundred service lines of ¾-in. pipe, all of which is to be welded., it being our intention to complete the entire plant without the use of a single fitting of any kind, with the exception of valves and stop cocks.

Welding 7.5 Miles of 10-In. Pipe

The writer desires to give his experiences in building approximately 7½ miles of 10-in. line during last fall on which this method of joining the pipe was used in place of couplings or collars. This line was laid through rolling country with the highest hills of probably 300 ft., being in some sections somewhat rough with a number of small ravines. The pipe was standard 10-in. I. D. line pipe furnished in long lengths which averaged about 35 ft. to the joint. In order to facilitate the welding we had the ends of the joints chamfered or beveled at an angle of 60 deg. which was done in the pipe mills without extra charge. By having the pipe thus chamfered the welder was able to start welding at once after the joints were lined up, otherwise it would be necessary that he melt down the edges of the pipe with the flame to secure a foundation before he would be able to start welding.

Heretofore in laying welded pipe we found that it was customary to lay the pipe in sections along the ditch and by turning the joints by means of tongs to allow the welding to be done on top of the pipe. We decided to make a little departure from this method and wherever the ground was suitable we laid the pipe joint by joint directly over the trench and did the welding without turning the pipe. While the welding was somewhat slower by reason of it being necessary to weld underneath the pipe, we found that we gained time in the end, as we were able to slack the pipe directly into the ditch after the welds were made and to make the bends the same as if we were laying sewer pipe; that is by building fires and heating the pipe wherever it was found necessary to place a bend.

Owing to the rough character of the ground, we were obliged to make a great number of these bends, but in nearly all cases they were made as the welding progressed. In a few places we had men go ahead and make bends which were placed in the line when the welder came up but as a rule this was only to gain time in some certain rough section of ground.

Testing the Joints

In testing out this line we used 100 lbs. of gas pressure from one of our compressor stations and when completed was found tight with exception of 5 leaks which were very small, being nothing more than little pin holes in the welds. These leaks can be easily repaired by placing additional metal upon the weld after the pressure has been taken off from the line.

During the laying of the line we subjected it to many severe tests in order to find out the strength of the welds and in only one case were we able to break them. For instance, we would hold the pipe up to the top of the trench with one of the wooden horses and lower it into the ditch on both sides of the horse, then we would suddenly let go of the pipe and allow it to fall without any support to the bottom of the trench, then at other times we would leave 5 or 6 joints swinging in order to test the strength of the weld. We would make the bends in some cases nearly at the weld but at no time did we have any trouble with them not holding, although the strain was very great where the bends were made without the line being blocked or braced. In fact we tried out the strength of the welds in every possible way in order to find out if there were any weak points in the construction of a welded line. In other words we did not want to give up the idea of welding our lines in the future unless it was proven to us that it was not practicable.

This one break which we had during the building of the line was caused by a poor weld, the pipe not being perfectly joined together, although at a casual glance it had the appearance of being as strong as any of the other welds; yet upon a more careful examination we found that the two pipes had been simply tacked together with metal and the iron melted in between them without being united and making a continuous pipe. Fortunately for us the welder who made this weld was discovered in time, otherwise we might have had more trouble with defective welds.

Contraction and Expansion

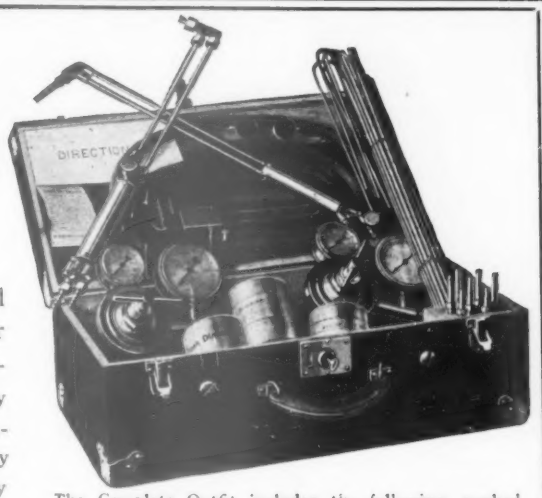
Before and during the building of this line there was considerable discussion as to the contraction and expansion on a welded line of this length, many holding that the line would pull apart at the welds owing to the contraction and expansion that they expected we would find on a line such as we were laying with only 20 in. of covering, that being the depth which we were having it buried. However, we did nothing to take care of this, as we took it for granted that the pipe itself would take care of any contraction or expansion that there might be. In other words, we figured that when the line was finished we would have one continuous joint of pipe the same as if we had secured a 7-mile length from the mill, and if it had been possible to secure such a joint of pipe, nobody would have thought it necessary to have it cut and expansion joints or sleeves put in.

In this connection I can advise you that we have not had the slightest trouble with the line pulling apart, although there has been some severe cold weather since the line was put in commission. There have been two breaks, the first one shortly after the gas was turned into the line, which upon examination showed plainly that it came from a defective weld in which the pipe had the appearance of being burned. The other break was caused by a sink in the surface of the ground at a coal mine and was a break which would have occurred on any line under like circumstances. Neither of these breaks showed any signs of there being contraction of the pipe, although the break at the mine took place during very cold weather.

The New B. B. B. WELDING and CUTTING OUTFIT, Complete

offers you unlimited opportunities for more business and bigger profits in all kinds of manufacturing and repair work. This outfit is the result of years of study and research by our engineering department; designed to insure the safety of the operator; all parts are made chemically as well as mechanically correct. You will be interested in our Diaphragm Safety Device; the special construction of our Regulators; and the many new features in the B-B-B Welding and Cutting Torches. This is a high-grade outfit for high-grade work and utmost safety—all parts are dependable, accurate and reliable—it is the outfit you need to get the biggest share of the welding and cutting profits.

Fill in and return the Coupon for our big complete catalog, showing details of construction, with prices, etc. No obligation to you.



The Complete Outfit includes the following, packed neatly in a durable case, with lock:
1 No. 865 Welding torch equipped with seven tips of various sizes; 1 No. 855 Cutting torch equipped with three tips; 15 ft. ¼" 3-ply rubber oxygen hose; 15 ft. ¼" 3 ply rubber acetylene hose, complete with couplings; 1 No. 1307 Oxygen Welding and Cutting Regulator; 1 No. 1327 Acetylene Welding and Cutting Regulator; 1 lb. Cast Iron flux; 1 lb. Copper-Brass and Bronze flux; 1 lb. Aluminum flux; 1 lb. Cast Iron welding rods; 1 lb. Aluminum welding rods; 1 lb. Iron welding rods; 1 lb. Bronze welding rods; 1 Pair Asbestos gloves; 1 Pair Goggles; 1 Wrench; 1 Book of Instructions.

The B. B. B. Company Cleveland, Ohio

Please mail your complete catalog of Oxy-Acetylene Welding and Cutting Apparatus, with prices, etc.

Name .....

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W. E. 7-'16

THE BISHOP-BABCOCK-BECKER CO.

General Offices and Factories, Cleveland, Ohio

Branches in the Larger Cities

Cost

To secure welders we were obliged to pay a rate somewhat higher than the regular rate, yet with this high cost of labor the cost of the welds came slightly under the price of standard couplings such as are generally used on like lines, but this being our first experience in this kind of main line construction our costs were likely greater than they would have been had our experience been more extensive. I believe that a welded line can be laid with such economy that the cost of the joints will not be over two-thirds of what it would be if couplings were used.

Welding Well Casing

It might be of interest to the members of the association to know that during the time which we were engaged in laying the line above mentioned that we tried out oxy-acetylene welding on casing at one of our wells known as the R. A. Geary well, or as it is more commonly known now, "The Deep Well." This well, on which we began work in November, 1911, is located about 4 miles out of McDonald, Pa., and at the time this paper was written had reached a depth of 7,181 ft., being by far the deepest well ever drilled in this country and only exceeded by one other well in the world. At the time of which I write we had in the well a string of 3½-in. I. D. or 4½-in. O. D. casing 6,320 ft. long with heavy collars.

In order to use a larger sized casing it was decided to pull out the screw pipe and run in a string of 5-in. with welded joints. The casing was furnished in 21 to 23-ft. lengths, the first 2,000 ft. being 5-in. O. D. or 4.29-in. I. D., 0.355 in. thick, weighing 17.611 lbs. per ft. Owing to the fact that there was an enormous water pressure on the lower casing it was heavier than that used above the water, which was 5-in. O. D. or 4.24-in. I. D., 0.288 in. thick, weighing 14.493 lbs. per ft., there being 4,320 ft. of this or a total length of 6,320 ft. in the string. On both weights the ends of the joints were chamfered 60 deg.

In placing the casing in the well there were two joints welded together outside of the derrick, then after the welding was completed these were placed in the hole and lowered down until only about 5 ft. remained above the derrick floor. Then two additional lengths were welded together in the yard as before and then brought into the derrick, raised and suspended in the air with the lower chamfered end resting upon the upper chamfer of the lower section previously placed in the well; then the welder proceeded to weld these sections together vertically, after which they were lowered into the hole.

In order to sustain as much of the weight as possible during the time that the casing was put in, a shoe was placed in the casing, this being an oak plug about 3 ft. long which was driven into the end of the first joint. It was the intention to drill this plug out after the casing had been placed; but when about ½ mile of pipe had been lowered into the hole the pressure of the water was so great that the plug blew out with great force. After this happened a second plug was placed in the next section; this plug likewise was of wood, but it also had a steel ring back of it. When all the casing had been placed in the well this plug was drilled out, leaving the casing free. When you realize that this string of pipe 6,320 ft. long with a weight of over 48 tons was to a great extent held by the last weld it will give you a very good idea of the strength of a properly made weld.

Before closing, I might say that we exercised great care in being sure that more metal was used at the weld than there was in the pipe itself. On this line we made it a point to have at least $\frac{1}{16}$ in. more and on the casing sometimes more probably $\frac{1}{16}$ to $\frac{3}{16}$ in. The strength of the weld depends wholly upon the amount of metal used and the care taken in welding the two together.

Trade News

WELDING IN FLORIDA.

The accompanying illustration shows a centrifugue pump which was successfully welded by the Forte Meade Welding Co., Forte Meade, Fla. The pump was 60 inches in diameter, with a 48-inch crack. Since welding the pump has been in steady use for three months, night and day, and pumps about two hundred and fifty tons every twelve hours. An oxy-acetylene outfit (Vulcan) was used in making the weld.

The Davis-Bournonville Company have published a new price list of oxy-acetylene welding and cutting supplies. A copy will be sent upon application to concerns interested.

Big Centrifugal Pump Successfully Welded by Forte Meade Welding Co.

Alexander Milburn Co., Baltimore, Md., have issued a folder dscribing oxy-acetylene welding and cutting apparatus, regulators, generators, etc.

The Railroad Master Blacksmiths' Association will hold its twenty-fourth annual convention at Chicago, beginning August 15th.

The Julius King Optical Company, 10 Maiden Lane, New York City, have recently issued a booklet entitled "Let Us Save Your Workmen's Eyes." All kinds of safety appliances for the eyes are described.

Mr. Harry L. Barnitz, Ph. G., a consulting engineer of 115 Broadway, New York, recently addressed the Aeronautical Society of America on the subject of "Electrolytic Production of Hydrogen." The address has been published in the form of a pamphlet.

The General Welding & Equipment Co., 107 Massachusetts Ave., Boston, Mass., have published a little booklet entitled "Instructions For Welding & Cutting." This book has been written, not only for the operator, but for "the man higher up" as well. The book contains instructions relating to the welding of all metals, as well as descriptions of equipment etc. The price is 25c per copy.

The Commercial Acetylene Railway Light & Signal Co. has changed its name to Commercial Acetylene Welding Co. and will hereafter devote itself *exclusively* to the production and sale of acetylene gas in cylinders manufactured under the Dalen and Claude & Hess patents, which patents are controlled by that company.

The railway and signal lighting end of the business will hereafter be conducted by the A. G. A. Railway Light & Signal Co. This change became effective July 1st.

"NO-ULTRA" WELDERS' GLASSES.

The Chicago Eye Shield Company, 2300 Warren Ave., Chicago, are manufacturing a new glass, called "No-Ultra," which excludes most effectively the ultra-violet rays.

A large percentage of the energy radiated from all illuminants consists of waves of no value in the production of vision. Outside the limits of the visible spectrum lie the infra red rays at one end, the ultra-violet at the other. It has recently been determined that excessive infra red energy not only tends to produce cataract and that the ultra-violet energy not only gives rise to fluorescence in the eye, which interferes with distinct vision, but also, if present in excess, causes serious and permanent injury.

Obviously, therefore, the best glass for welding, etc., is the one which excludes most effectively the ultra-violet and infra red radiation. Moreover, since the sensation of glare is mainly due to violet and blue light, it is frequently of advantage to use a glass which cuts off both the violet and blue rays.

"No-Ultra" lenses, the result of several years' research, is a new glass; affords the eye absolute protection against ultra-violet, violet and blue rays, and at the same time absorbs a large percentage of infra red rays. It does not show any appreciable absorption in the rest of the spectrum and on that account permits a clearer vision, both near and far, than can be secured by the use of other lenses, such as deep green, smoke or blue.

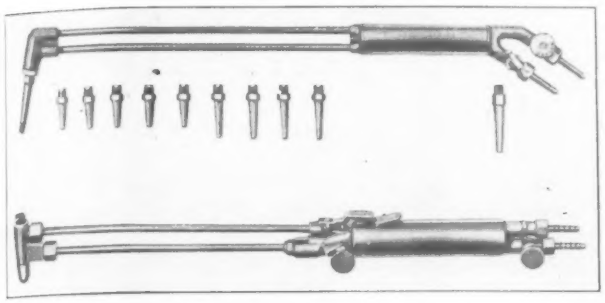
B-B-B TORCHES AND REGULATORS

A new line of welding and cutting apparatus has been placed on the market by the Bishop-Babcock-Becker Co., of Cleveland. The line includes regulators; pressure gauges, welding and cutting torches, decarbonizing devices, etc. The regulator and safety device is illustrated herewith. It is a positive-acting device that automatically relieves any excess pressure in the valve which may be caused by cracking, creeping, or destruction of the seat; or the depositing on it of iron rust from oxygen cylinder; or by carelessness of the operator. B-B-B torches are also illustrated. This torch possesses the following advantages:

It is light enough to use continuously without fatigue; yet is strong enough to withstand the ordinary abuse.

It mixes the gases in equal proportions—a point often lost sight of by the user. This feature not only makes a distinct saving in oxygen gas, but results in a more perfect welding flame.

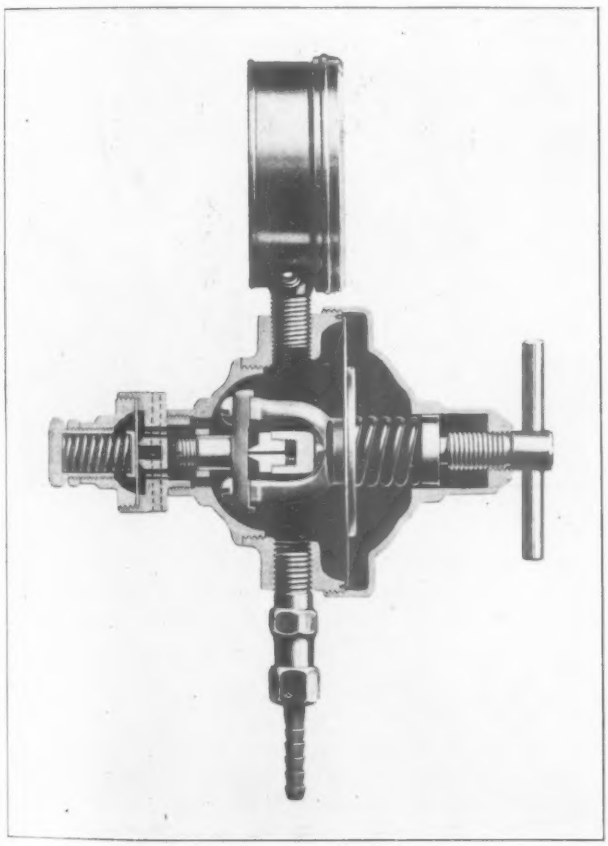
The right welding torch will give a neutral welding flame,



B-B-B Torches.

neither oxidizing nor carbonizing; and an operator can learn to use successfully a torch of this character much quicker and with far better results than he can one where the gases are improperly mixed, and the resulting flame harmful in its effect upon the metals welded.

The B-B-B welding torch is 24½ inches long over all;



B-B-B Regulator and Safety Device.

handle is 1¼ inches in diameter, and it will be noted the shut-off valves are conveniently placed—easy to control with the left hand while holding the torch with the right hand; yet they do not interfere with the arm or the clothes of the operator.

Attention—Jobbers

Buy your Cast Iron—Aluminum—Manganese rods direct from the Manufacturer. Special Welding and Cutting Torches designed and manufactured for you.

Superior Oxy-Acetylene Machine Co.
Hamilton, Ohio
Long Distance 474-R **Night Call 1276-R**

CYLINDER VALVES

High class material and construction.
A lot of 500 to 600 for immediate delivery.

ARTHUR W. DOHMEN, 507 Niagara St., Buffalo, N. Y.

Become a Jobber

Inquiries and orders for welding machines and supplies have come to us through this ad. Many of these firms ordering material and supplies have to wait a long time and pay excessive charges for their goods.

We are therefore compelled to turn these inquiries over to jobbers in the states from which these orders come, who can ship the goods wanted quickly and at low rates.

The proposition is a good one and one which will make money for the jobbers who will handle the goods. Write us regarding the selling of welding supplies.

Become a JOBBER

WELDING MATERIALS

720—115 South Dearborn Street
CHICAGO

The Superior Oxy-Acetylene Welding and Cutting Equipment

You will eventually buy the SUPERIOR Welding and Cutting equipment—Welding and Cutting Torches, Regulators, Gauges, Cast Iron, Aluminum, Tobin, Manganese, Fluxes, etc.
Write for free samples of supplies and catalog.
All makes of welding and cutting equipment repaired.

Superior Oxy-Acetylene Machine Company
Long Distance 474-R **Hamilton, Ohio** **Night Call 1276-R**

WELDING PHOTOGRAPHS

We make a SPECIALTY of photographing welding jobs

Chicago Architectural Photographing Co.
140 So. Dearborn Street **Chicago, Illinois**

At the recent eleventh annual convention of the Natural Gas Association of America, held in Pittsburgh, several manufacturers in the welding field made exhibits, among them being the Davis-Bournonville Co. and the Oxweld Acetylene Co.

At the Railway Supply Manufacturers' Association Exhibit, held on Youngs Million Dollar Pier, Atlantic City, in June, the following exhibits will interest the welding trade:

Acme Supply Co., Chicago—Welded steel shapes.

Byers Company, A. M., Pittsburgh—Welded pipe.

Carbic Mfg. Co., Duluth—Carbic oxy-acetylene welding and cutting generator and apparatus.

General Electric Co., Schenectady—Standard portable arc welding equipment.

Gilbert & Barker Co., Springfield, Mass.—Welded tanks and barrels.

Goldschmidt Thermit Co., New York—Thermit and appliances for Thermit welding; sample welds; samples of carbon free metals and alloys produced by the Thermit process; large sample weld on a 9-inch crank shaft; materials and appliances for demonstrating pipe welding for the purpose of welding locomotive superheater units; sample of superheater unit welded by the Thermit process.

Hauck Mfg. Co., Brooklyn—Preheating devices.

Draper Mfg. Co., Port Huron, Mich.—Pneumatic flue welding machines.

ANNUAL MEETING OF ACETYLENE ASSOCIATION

The nineteenth annual meeting of the International Acetylene Association will be held at the Murray Hill Hotel, New York City, July 25th, 26th and 27th. Matters of importance to come up for discussion makes this convention of great interest to the acetylene field. A list of speakers including many of the men most prominent in the field has been arranged. Among other subjects to come up for discussion are the following:

New insurance rules governing entire industry in view of complete revision by insurance authorities and the United States government.

Surprising development of the use of blow pipes.

Mine lighting.

Problems brought about by the war.

Supply of oxygen.

Use of acetylene for lighting.

How to meet prospective competitors.

DAVIS-BOURNONVILLE EMPLOYES' BANQUET

During the past four years the employes of the Davis-Bournonville Company, manufacturers of oxy-acetylene apparatus, with general offices and factory in Jersey City, have held an annual banquet at which the officers of the company were guests of the employes.

The banquets have usually been held early in January, but this year the fourth annual banquet was deferred for the completion of the company's new factory building and was held on Monday evening, May 22nd, dedicating the new building. There were over three hundred present, including representatives from the company's different sales offices, and the guests were the officers and the directors of the company and their wives.

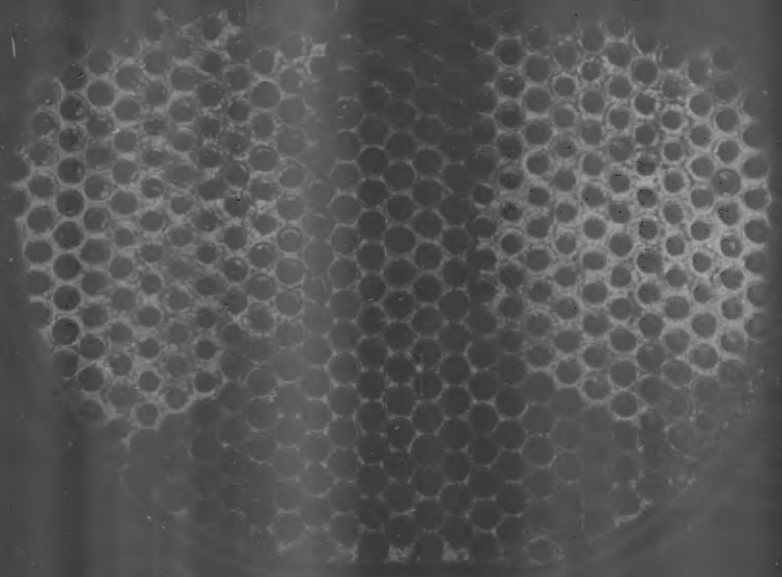
The speakers, following the banquet, and introduced by Mr. H. R. Swartley, Jr., as toastmaster, were Mr. Augustine Davis, president of the company; Mr. C. B. Wortham, secretary-treasurer; Mr. Eugene Bournonville, now retired from the company; Mr. Charles J. Mayer, president of the Electric Service Supplies Company, Philadelphia; Mr. William G. McCune, treasurer Otis Elevator Company, New York; and Mr. DeWitt V. D. Reiley, attorney, New York, the last three gentleman, with Mr. Harold Rowntree, Chicago, and Messrs. Davis and Wortham, constituting the board of directors.

Davis-Bournonville Employes Hold Banquet.

Supt. W. C. Bucknam was the last speaker and concluded his talk by inviting Mr. Davis to press the electric button which started the machinery in the new building, and, in the presence of the diners, a welding tip was made and presented to the president of the company as the first piece of apparatus made in the new factory.

The new factory building gives 30,000 additional square feet of floor space for manufacturing purposes. The general offices of the company in the old building have been remodeled with double the floor space formerly occupied.

Carbon electrode used for cutting or heavy current welding



Metal electrode builds up or fills cavities when welding

Light portions show welded tube ends in locomotive

BENEATH the C & O locomotive illustrated above, which has welded seams and flue sheets, is shown a partly completed locomotive flue sheet. The light portions show flue ends which have been welded by a G-E arc welding outfit, one type of which, used by the American Locomotive Company, is shown at the bottom of this page.

This welder does its own chipping, so work can go on when your chippers are busy elsewhere. The control of heat and building of metal possible with this welder prevents distortion, uneven crystallization and cavities.

A G-E arc welder will repair worn or broken parts while they are in place. Our nearest office will be pleased to give you additional information.

General Electric Company

General Office: Schenectady, N. Y.

District Offices in:

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Chicago, Ill. Denver, Colo. San Francisco, Cal. St. Louis, Mo.
Sales Offices in all Large Cities

6242

New neck cast on to large roll made with the aid of Thermit and having the pods cast in at the same time.

Large bevel gear on which two new teeth and crack have been repaired.

Four Thermit welds on locomotive frame on the Missouri Pacific Railroad, made without removing the frame from place.

New crank pin welded in by the Thermit Process.

We Are Prepared

To Undertake at a Moment's Notice the Handling of Any Serious Breakdown

Breakage and wear in steel mills and other manufacturing plants has been greater at this time than ever before.

We have been called upon by so many large iron and steel companies recently to make quick repairs to broken rolls and pinions, connecting rods, shears, crank shafts, locomotive frames, and many other sections, the breakage of which often means a serious delay in the operation of the plant, if not a complete shut-down.

Wire or telephone our nearest office and we will proceed at once for arranging the shipment of materials and send an expert to supervise the repair.

We have an eighty-page pamphlet devoted exclusively to this class of work, which is known as pamphlet No. 1779, and tells how the work is executed and how you can do the work yourselves.

Goldschmidt Thermit Co.

William C. Cuntz, General Manager

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New York

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